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And Shipping Age

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What Is a Fair Price for New Vessels?

FROM various sources we have, during the past few months, gathered the impression that there is a very general feeling among shipowners and prospective shipowners—the latter being, unfortunately, hard to find—that the prices at present quoted on new vessels by American shipbuilders are out of line, it being held that the increase in material and labor rates since 1913-14 are less than the corresponding increase in price of ships.

While recent ship quotations, judged by pre-war values, are undoubtedly high, it has been our impression, in most cases, that they represented the minimum the builder had the courage to undertake in order to hold a skeleton organization together and remain in business.

With the average age of a large number of privately owned American vessels approaching thirty years, and the idle Shipping Board fleet containing few, if any, of the special types of vessels required by the coast trade or for fast intercoastal service, there can be no doubt of the existence of a potential demand for new merchant vessels. How long a time may elapse before trade requirements make necessary the construction of new ships there is no means of determining, but the writer has been informed by several interested parties that the demand is already sufficient to warrant the construction of new vessels and that orders would be placed were it not for a feeling, on the part of the prospective owners, that present prices are too high and that more advantageous terms may be obtained as a result of delay in placing contracts.

In order to compare pre-war and present prices, we have made two approximate estimates of the cost of an ordinary single screw cargo steamer of 10,000 tons deadweight and 10 knots service speed, in the first using material and labor rates obtaining in 1913-14 and the second based on present prices. In both cases, the amount of material used and the hours of labor expended are proportioned from the construction records of actual vessels ranging from 8,000 to 11,000 tons deadweight. Adding to the estimated cost of material and labor 50 percent of the latter for overhead expense and to the total of material, labor and overhead, 10 percent for profit, gives a pre-war price of $571,000 or $57 per deadweight ton in round numbers. Figured in the same manner, the present-day price comes to $1,128,000 or approximately $113 per ton; the increase over the pre-war figure being very nearly 96 percent.

In the period covered, the price of slip steel has increased over 100 percent, freight rates have more than doubled, and the prices of other materials entering into ship construction have increased 60 to 150 percent. The rates per hour for skilled mechanics have increased from 75 to 85 percent and for unskilled labor about 125 percent.

We have assumed that the same total of man-hours would be required to build the vessel in both cases; in other words, that the efficiency of operation of the shipyards is as high at present as it was in 1913-14. When present conditions in the yards are taken into consideration it at least appears doubtful if this assumption is warranted.

To this point, the figures are our own, and while they indicate that an increase in price of from 90 to 100 percent over pre-war rates is entirely justified, they represent the judgment or opinion of a single individual, not at present actively engaged in shipbuilding, and can only have what might perhaps be termed a contributory value.

In order to place before our readers information of a more positive character, we have communicated with five of the leading shipyards, requesting them to state their opinion as to a fair pre-war and present price for a cargo steamer of the size and character before mentioned. All five yards have furnished the desired information, the mean of the prices quoted being as follows:

Pre-war price for 10,000 D.W.T. steamer, $55.90 per ton.
Present price for 10,000 D.W.T. steamer, $103.30 per ton.
Increase of present over pre-war price, 85 percent.

If our own estimates are reasonably correct, it is certainly most apparent that the shipyard prices are not out of

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line on the high side. On the contrary, they represent optimism on the part of their managers, as to the possibility of obtaining high efficiency or, on the other hand, an actual cut in price, regardless of estimated cost, to meet depressed trade conditions. In any event, no material reduction in ship prices can be expected, unless there is a drop in cost of material and labor, and of this there is, at present, no prospect.

If, as appears to be the case, an actual need for new ships of special types exists, we trust that the shipyards, already sorely tried, may not be compelled to submit to a still further period of depressing and possibly destructive inactivity, while prospective owners wait for a condition which, judging from present indications, may never be realized.

Oil

IN view of the uproar in Congress over the leasing of the Navy's oil reserves and the general impression which the Senate's oil investigation has created in the mind of the general public of laxness and possibly criminal waste on the part of certain government officials, it is a relief to be able to state that one government agency, at least, is effecting a very substantial saving of oil.

We have several times, in these columns, had occasion to call attention to the efficiency and high technical attainments of certain employees of the Shipping Board and have expressed the wish that the Board might be so constituted that the work of these men would receive such recognition as would render their efforts productive of constructive results.

In one department these results have been produced, for we believe it to be the unanimous opinion of such competent engineers as are familiar with the subject that the work of the Fuel Conservation Section of the Emergency Fleet Corporation is of far reaching importance and of great value, not only to the government, but to private shipowners and operators as well.

Called into being as a result of the irregular and generally unsatisfactory engineering operation of many Shipping Board vessels, the Fuel Conservation Committee, consisting of both Shipping Board and outside engineers of recognized standing, was organized in July, 1922. This committee, working through the Fuel Conservation Section of the Emergency Fleet Corporation, has determined standards of performance for all classes of Shipping Board vessels; established ratings for engineers as determined by the performance of their vessels in comparison with these standards and furthermore has established effective means of training engineers in the use of oil fuel and of correcting defects on such ships as show unsatisfactory performance and excessive fuel consumption.

The work of the Fuel Conservation Committee and Section was first brought to the general attention of engineers and ship operators by a paper read before the Society of Naval Architects and Marine Engineers in November, 1923, by Joseph E. Sheedy, vice-president of the Emergency Fleet Corporation. It has evoked most favorable comment, both here and abroad.

It has appeared to us that the methods employed by the Fuel Conservation Section, in determining standards of turbine and engine performance are of interest to all engineers, particularly to those in any way responsible for ship operation, and to this end we have requested Messrs. Brelsford and E. A. Stevens, Jr., of the Emergency Fleet Corporation, the gentlemen primarily responsible for the development of the standards described in Mr. Sheedy's paper, to undertake the writing of a series of articles, describing their work. The first of these appears elsewhere in this issue.

It must be remembered that the aim was not to establish the maximum possible performance but a fair average which it seemed reasonable to expect a competent engineer could obtain from his machinery.

In establishing the various standards of performance, a very large amount of work relating to the efficiency and economy of turbines and engines was necessary, and it is with the hope of making the results of this fundamental work available for the use of our readers that the present articles have been undertaken.

The effect of the work of the Fuel Conservation Committee became almost immediately apparent in improved performance of Shipping Board vessels and the absolute saving in fuel brought about by the establishment of the standards of efficiency for the various vessels has already reached a surprising total.

The following figures give an idea of the fuel savings effected:

25 cargo ships of various types, oil burning...	11 percent
Several cargo ships of various type, coal burning	6½ percent
535-foot passenger and cargo ships, oil burning	5½ percent
502-foot passenger and cargo ships, oil burning	6 percent
Ex-German ships, coal burning.....	6½ percent

The managers of several private lines have expressed their appreciation of the great value of work of this nature and their desire to inaugurate similar methods on their own vessels. We trust that the forthcoming articles may prove of real value to them and to all others who are interested in the economical operation of steam vessels.

The Preservation of Steel Ships

THERE is, perhaps, no subject of more vital interest to both the shipbuilder and the ship operator than the proper protection of steel against the various destructive agencies which attack a vessel's hull. Ordinary ship steel, when not covered by paint or other impervious material, is peculiarly susceptible to both chemical and electrolytic action and the uncertainty as to the presence of conditions favorable to such action, together with the rapidity with which corrosion may take place under favorable conditions, make its prevention a matter of vital importance.

Protective covering, however good in quality, is of little use unless properly applied to a surface which has been suitably prepared to receive it. In the case of new vessels the factor which in the majority of cases is responsible for imperfect protection of the steel is the presence of mill scale or black oxide on its surface. This substance forms in the rolling mill and covers more or less completely all steel plates and shapes. It adheres very closely and is difficult to remove except by immersion in an acid bath or pickling, a practice

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very rarely followed except in the case of naval vessels. In the average merchant vessel, no attempt is made to remove mill scale, except by a more or less perfunctory wire brushing and cleaning and the paint applied during construction is consequently very largely over mill scale. The scale loosens rapidly under water and more slowly when exposed to the atmosphere—in either case it eventually drops off, taking the paint with it.

That a considerable amount of the painting done during the construction of a steel vessel is wasted is a fact that we believe will be generally admitted by practical shipbuilders, but precedent and tradition are hard to overcome and, because it has been done in the past, paint is applied during construction under conditions which, to say the least, make the permanency of its protection very doubtful.

It would appear that except in such places as back of joiner sheathing where it is inaccessible, the painting of the steel should be delayed as long as possible thus aiding the loosening of the mill scale by atmospheric action. This is particularly true as regards the bottom of the vessel and, when docking is assured within a month or so after launching, there seems to be no good reason for not leaving the bottom plating entirely bare of paint at the time of launching. If this is done and the ship is allowed to remain in the water for a comparatively short period, it will be found, upon docking, that the scale has dropped off or has become so loosened as to be easily removable. The paint can then be directly applied to the bare metal with the assurance that so far as mill scale is concerned no further difficulty will be experienced.

Aside from the removal of mill scale, the steel should be thoroughly clean and dry before paint or cement coating is applied to it. It is safe to say that by far the larger part of the difficulty with ships' paint arises from carelessness in applying it and not from any inherent defect of the paint itself.

The first coat on a clean steel surface should be thin in order that flow may be free and all minute imperfections in the surface filled. When pitting has commenced, this is particularly true as it is found that, after pits have reached any considerable size, minute cracks develop from them in the direction of the length of the plate or bar, and serious corrosion follows. The following coats can be thickened as necessary to produce a hard and effective coating.

In the maintenance and upkeep of completed vessels the question of protection is of even greater importance than during the constructive period. Certain kinds of cargo are particularly detrimental in their effect upon steel, and such parts of the structure as are subject to heat or to considerable changes of temperature are peculiarly susceptible to the action of damp air and condensation. These conditions can only be overcome, or their effects neutralized, by constant watchfulness and care, and to this end the efforts of the ship designer and shipbuilder should be constantly directed to the providing of easy access to all important parts of the ship's structure. Too little attention is often given to this very essential matter in the earlier stages of a design with the result that the average vessel has many obscure "corners" which are neglected because of the amount of time and energy which must be expended in order to properly care for them. If more ship draftsmen had had actual experience with the care of the vessels for which they make the plans, these conditions would undoubtedly receive more consideration than it is now usual to give to them.

High powered, lightly constructed vessels call for particular care in the prevention of corrosion and unfortunately these are the very ships where crowding and consequent inaccessibility most often exist. It can best be met by pickling all material which is eventually to be covered or inaccessible to remove the scale and then protecting it with bitumastic enamel or other similar substance. The right material, properly applied will ordinarily last as long as the period of useful life of the boiler, tank or other obstruction which covers it.

The peculiar liability of steel to corrode when exposed to both heat and dampness has been mentioned. To this end, the thorough insulation of boilers, uptakes and steam pipes may be almost as beneficial in its effect as proper painting. Tank tops and inner bottom floors and framing in the way of boilers are in particular subject to damage by combined heat and moisture which may be largely avoided if the bottoms of the boilers are insulated. When this is done, however, care must be taken to prevent the bottom insulation from becoming a catch-all for leaks in the shell and thus, although protecting the tank plating, causing damage to the boiler itself.

In every vessel, the preservation of the steel structure resolves itself very largely into a matter of vigilance and care on the part of the designer, the builder and the operator to the end that the ship is so laid out that she can be properly cared for, that no paint or cement is applied until the surface to receive it is really clean and dry and finally that all parts of the completed ship receive constant and careful attention on the part of those responsible for her operation and upkeep. That it is all largely a personal matter has been repeatedly proved by the wide variation in wasting and deterioration shown by sister ships painted with similar paints and operated under similar conditions but by different managers.

Ship Economics

THE determination of the type and size of ship best suited to a given service is a problem constantly before the shipowner. It is, however, of such a complex nature that the application of the results of any general or theoretical study to the solution of a particular case is likely to be rather unsatisfactory and of little practical value.

In any investigation of this sort, it is first necessary to establish more or less hypothetical conditions upon which to base one's calculations. The conditions surrounding the operation of vessels in different trades are of such a nature that it is obviously out of the question to formulate any general rules covering all cases with equal accuracy. All that can be hoped for is an indication of the tendencies produced by varying certain assumed conditions, while others remain constant, and quantitative results of any value can only be obtained for individual cases, where the conditions upon which the problem is based are definitely known.

We do not wish to imply that such investigations have no real value. If properly carried out, they undoubtedly indi-

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cate general laws which affect, in greater or less degree, any individual case, and the methods used are of interest as applying to the solution of a particular problem.

Two studies of this description have recently come to our notice. One, by Prof. L. B. Chapman, outlining a method of determining the best size of ship for a particular trade, appears elsewhere in this issue. The other, a paper entitled "Influence of Type of Propelling Machinery on the Running Costs of Ships," was read before the Northeast Coast Institution of Engineers and Shipbuilders by Mr. W. G. A. Perring.

A comparison of the assumptions upon which the two authors base their calculations is interesting. Both have fixed freight rates to give a return of 10 percent on the initial investment. In the first paper the assumption is made that the ships carry an average cargo of 80 per cent of their full capacity. In the second, full cargoes are assumed to be carried. In a comparison of steamers and motorships, these assumptions have a direct bearing upon one of the principal advantages claimed for the latter type of vessel—its greater cargo capacity. If ships carry an average load of 80 percent of their total capacity, it would appear that the relatively small gain due to the type of machinery becomes of secondary importance. It seems to us, however, that the motorship and the oil burning steamer should receive credit for their larger cargo capacities. In all lines of service the amount of cargo carried is subject to fluctuation, and while there are certain periods when a full cargo is not obtainable, there are others when more is offered than can be handled. Whether these conditions can be averaged in such a way as to indicate the mean yearly loading necessary to pay a certain return on the investment, we are not prepared to say, but in any event, it is obvious that a type of machinery which gives to a ship a greater maximum capacity makes that ship potentially more valuable.

Both papers show clearly the great effect upon the earning capacity of a vessel of the rate of discharge of cargo and stevedoring costs. For short voyages these charges may easily amount to 20 or 25 percent of the total running cost and sometimes may exceed the fuel bill. It is evident that a rearrangement or change in type of cargo handling gear may effect a radical change in the comparative values of different sized ships for a given set of voyage conditions.

While Prof. Chapman's article deals only with motorships of a single type, the methods used may be applied to vessels having steam machinery. Mr. Perring compares the operating costs of steamers having reciprocating, turbine or turbo-electric machinery and Scotch or watertube boilers and also of motorships having two or four cycle engines or Diesel-electric drive, thus covering all types of propelling machinery which are in practical use.

Assuming reasonable rates of fuel consumption for these various classes, their comparative cost of operation must obviously be largely dependent upon the price of fuel. Mr. Perring naturally bases his figures upon English prices, fuel oil being valued at double the price of coal, and Diesel oil one-sixth higher than fuel oil.

In so far as the conclusions which he draws are affected by fuel costs, they are not directly applicable to American operation. They are, nevertheless, of general interest although the data upon which his calculations are based differs, in some respects, rather materially from that dictated by experience in the operation of vessels on this side of the Atlantic.

For steamers, the following statement is made: "The analysis shows that the coal-fired ship can compete successfully with the oil-burning ship, provided the price of coal is approximately half that of boiler-oil. In the calculation, the space factor has not been considered; it being assumed that the coal needed could be bunkered. It would appear that for short trips it is more profitable to use oil, but in long ocean voyages the coal-burning ship becomes a better paying proposition."

In assuming that all coal needed can be bunkered, it would appear that one of the great advantages of oil-fuel has been discarded as, for long voyages, the coal-burner cannot bunker sufficient fuel for the round trip and must take on additional supplies available in foreign ports, which at once upsets the calculation.

As to motorships—"It will be noticed that it is only on extremely long voyages that the Diesel ship possesses any advantage over steam; this is mainly on account of the higher first costs. A difference will be seen in the case of the Diesel-electric which, for voyages of 3,000 miles and upwards, shows a marked superiority over all other types of drive. Its advantage for the shorter voyages over the other motorships is because of the lower port fuel consumption assumed for the electric auxiliaries: for long voyages it is first cost alone that enables it to run more profitably."

Apparently the "Diesel-electric" is the only ship credited with having electrically operated deck machinery. Practically all first class motorships have electrically-driven auxiliaries. We can see no reason why the fuel saving qualities of this system should be considered as belonging exclusively to vessels having Diesel-electric propelling machinery. Concerning long voyage efficiency, although we have no reliable data as to the initial or operating costs of Diesel-electric ships, we very much doubt that their first cost is less than that of direct drive ships, and where a constant sea speed is desired, as is the case with cargo vessels, it would appear that the operating costs must necessarily be somewhat higher than those of the latter type.

We have written somewhat at length regarding this analysis of ship operation, not in any spirit of criticism, but solely to draw attention to the complexity of the problems involved and to the possibility of applying to their solution scientific and logical methods. In justice to both the writers whom we have mentioned, it must be said that each states clearly that his results and conclusions are not to be considered as final and positive in any sense, and are mainly valuable as indicating how, once the contributing factors are correctly determined, the problem of determining the most economical ship may be satisfactorily solved.

Investigations of the sort under consideration involve a large amount of research and study but the investment of time and thought is well worth while. Although exception may be taken, to the conclusions arrived at, the main value of such work, and it is great, lies in the application of sound and logical methods to the solution of an involved, but very practical and important problem.

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Shipping Legislation in Congress Lags

Numerous Bills Introduced — Palmer to Reduce Fleet Corporation Expenses—New Shipping Board Commissioners

By Harold F. Lane

WASHINGTON, D. C.

CONGRESS has been devoting much more attention to politics than to legislation ever since the present session began in December but numerous bills pertaining to shipping continue to be introduced and referred to committees, where most of them will continue to repose. Several bills are now pending to abolish the Shipping Board and another was introduced in the Senate on January 24 by Senator Walsh of Massachusetts, who would transfer the functions of the board to a bureau of merchant marine in the department of Commerce, retaining the Fleet Corporation as the government agency for operating the vessels. Senator Edge of New Jersey has also introduced a bill, S. 2555, to segregate the judicial and administrative functions of the board, reorganize the Emergency Fleet Corporation and decentralize the operation of the government fleet. Senator Edge said he was convinced that much of the deficit annually piled up by the board is "caused by the lack of business management because of the confused and overlapping conditions invited under existing law." The bill also provides for the subdivision of the fleet corporation into subsidiary organizations for different services. Senator Edge gave notice that he proposed to ask the committee on commerce to appoint a sub-committee to give the bill consideration and hold hearings.

Investigation of the Shipping Board Called For

Resolutions providing for an investigation of the Shipping Board and the Emergency Fleet Corporation have been introduced in the Senate by Senator King of Utah and in the House by Representative Davis. The King resolution, after a preamble regarding the alleged "wasteful, extravagant and improvident practices," provides for the appointment of a committee of five senators to investigate the affairs of the board and the Fleet Corporation "and to ascertain the present condition of each of said organizations, the amount of their assets, the present sale value of the property of the government under their control, the amount of pending claims against and the existing liabilities of said Shipping Board and Emergency Fleet Corporation, the amount of claims which have been paid, the manner of operating government ships and conducting the business of said Shipping Board and Emergency Fleet Corporation, and other pertinent and cognate matters connected therewith, and to report to the Senate its findings, together with its recommendations, for the prevention of said abuses, and the future disposition and administration of the shipping property of the government." Representative Davis' resolution provides for the appointment of a select committee of seven members of the House to conduct an investigation.

Commenting on these resolutions a statement issued by the National Merchant Marine Association says: "In the search for campaign material both parties are seeking to bring to light anything that can be used to their advantage, and if a Shipping Board investigation is made, it will probably be a lengthy one. If the energy that seems to be available in Congress for this purpose were used for the benefit of the merchant marine, legislation might be secured that would aid the development of an American merchant marine."

Senator La Follette has introduced a bill to require that every seaman shall be provided with and shall always keep a continuous discharge book containing a description and signature of the owner, in which shall be entered a record of his voyage, service and rating by a shipping commissioner. The bill also contains provisions regarding the payment of wages and disciplinary matters.

Chairman Butler of the House naval committee on February 3 introduced a bill to authorize a $97,000,000 naval construction program, which would include eight new scout cruisers to cost $11,000,000 each and six river gunboats at $700,000 each, exclusive of armor and armament. The bill also would provide for alterations to the battleships *New York* and *Texas* to afford additional underwater protection.

Fleet Corporation Seeks Economy

President Palmer of the Fleet Corporation is studying ways in which to economize in the expenses of the corporation in view of the reduction in its appropriation recommended by the Bureau of the Budget, from $50,411,500 for the fiscal year 1924 to $36,000,000 for 1925. He is working on the plans for the proposed consolidation of services, which has been under consideration for several months under the former administration of the Shipping Board and the Fleet Corporation, and on February 20 it was announced that on his recommendation the Shipping Board had approved an aggregate reduction of $18,000 annually in the salaries of the four vice-presidents of the Fleet Corporation. Seven thousand dollars was cut from the pay of each of the two receiving $25,000 and $2,000 from each of the two receiving $20,000. Additional salary reductions will be made, Mr. Palmer said, adding that he had found some duplications of work and surplus personnel.

The word "emergency" has been omitted in the lettering on the doors to the offices of President Palmer, leaving the words "Fleet Corporation." On their recent trip to Europe both Mr. Palmer and Former Chairman Farley were impressed by the fact that foreigners emphasized the word "emergency" in asserting that the American lines would not be depended upon for continuous service. The word is a part of the legal name of the corporation but Mr. Palmer believes that until there is some legislation amending the merchant marine act so that it can be changed it will be advantageous to omit the word in ordinary usage.

Shipping Board Appointments Confirmed

Acting on a favorable report from the committee on commerce the Senate on January 28 confirmed the President's nominations of W. S. Hill, of South Dakota, F. I. Thompson of Alabama, and Bert E. Haney of Oregon as members of the Shipping Board. Later the President announced the appointment of Commissioner T. V. O'Connor as chairman of the board, succeeding Edward P. Farley, resigned, and the board has elected Commissioner E. C. Plummer, vice-chairman, succeeding Mr. O'Connor.

Senator Ransdell of Louisiana has introduced in the Senate a resolution calling on the Shipping Board to inform the Senate if plans were under consideration to move the Fleet Corporation offices from Washington to New York and also to "submit such plan, if any, to the Senate for approval before any action is taken thereon." Senator Jones called up the offices of the board by telephone and informed the Senate that no such action was contemplated but Senator Ransdell insisted on a formal answer and the resolution was passed. President Palmer of the Fleet Corporation assured newspaper men that nothing of the kind was contemplated.

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Great Lakes Shipping Establishes New Records

Vessels Moved 121,029,004 Net Tons of Iron Ore, Coal, Grain and Stone in 1923—Prospects for Coming Season Good

SHIPPING on the Great Lakes in 1923 shattered all previous tonnage records, according to the annual report of the Lake Carriers' Association, which has just been issued, and the prospects for 1924 indicate that almost as large a volume of freight will be handled during the coming season.

Previous Records Broken

In approximately seven and one-half months in 1923 the vessels engaged in the trade between Lakes Superior and Michigan and to the foot of Lake Erie moved 121,029,004 net tons of iron ore, coal, grain and stone as against the war-time high water mark of 117,052,686 net tons achieved in 1916. Moreover, the past year's Lake commerce exceeded the total transportation of the American year of entry into the war by nearly 6,000,000 tons, the critical war year of 1918 by nearly 7,000,000 tons and excelled the best previous record for peace times, attained in 1920, by 15,500,000 tons. The record of the past year again brings into prominence the potential strength of the fleet and unerringly points out its ability to cope with any emergency that may arise in the course of regular trade or in periods of crisis.

After the unusually severe ice conditions of the spring had been removed, low water was the only restraining influence to what might be summed up as an ideal season of navigation. Not in 21 years were the Great Lakes so free from devastating gales. Moreover, the season ended without the loss of a single seaman as a result of shipwreck. In fact, seven years have now passed without the loss through the stress of weather of a steel bulk freighter or of a seaman aboard such a ship.

Commodity Shipments

As in all years of heavy traffic, iron ore was predominate. Between May 1 and December 1 the movement totaled 59,036,704 gross tons which was the fourth largest in history and the largest known in time of peace. This commodity was moved at vessel rates 20 cents below the previous normal year 1920.

The cargo movement of soft coal, amounting to 29,656,557 net tons, was the largest in the history of the Lake trade. It exceeded the shipments of 1918 by 1,503,240 tons and basic rates were from 5 to 10 cents a ton cheaper than in 1920. Shipments of hard coal, amounting to 3,480,471 net tons, while seemingly adequate for requirements, were below the average.

The movement of stone has gained so rapidly and has reached such proportions that this commodity must henceforth be classed with ore, coal and grain as a factor in Lake commerce. In the year just closed, the stone movement totaled 9,920,422 net tons representing an increase of 2,098,442 net tons over the record figures of 1920. From a tonnage standpoint, stone is now almost at parity with grain as a Great Lakes cargo.

In comparison with 1922 and again with 1921 the volume of American grain shipments was disappointing. The combined movement from Duluth, Superior and all the grain ports on Lake Michigan amounted to only 113,881,796 bushels which, in comparison with one year ago, was a loss of 121,432,720 bushels, but the Canadian grain movement was so overwhelmingly record breaking, having totaled 296,871,360 bushels, that the season's shipments of 410,753,156 bushels, equal to 11,625,150 net tons, proved to be the third largest on record. In addition to this, the ton-movement of mixed sample grains and screenings totaled 225,297 tons, making 11,850,446 net tons as the complete ton-movement of grain.

Grain Rates

Grain rates were subject to acute fluctuations. While low ebbs were reached in different periods of the navigation season, these periods were always characterized by sharp recoveries so that, as a whole, the grain rates for the year were remunerative. The average grain rate for the season from Lake Michigan was 3 cents; from Duluth, 4.17 cents and from Fort William 4.62 cents. The season's average from all loading ports on the Lakes was 4⅛ cents.

Summary of Lake Traffic

The following table covers the total shipments for 1923 of each commodity carried by the bulk freighters with comparative figures that go back to 1915, attention being called to the fact that iron ore is given in gross tons and the grand total movement is expressed in net tons:

Year	Iron Ore Gross Tons	Coal	Grain of Various Kinds	Stone Net Tons	Total Net Tons
1923.....	59,036,704	33,137,028	11,850,446	9,920,422	121,029,004
1922.....	42,613,726	19,868,925	14,267,020	7,592,137	89,454,848
1921.....	22,300,726	26,660,652	12,470,405	3,925,705	68,033,575
1920.....	58,527,226	26,409,710	6,736,348	7,821,980	106,518,531
1919.....	47,177,395	26,424,068	6,091,703	6,407,285	91,761,238
1918.....	61,156,732	32,102,022	6,548,680	7,467,776	114,614,018
1917.....	62,498,901	31,192,613	7,161,716	6,748,801	115,100,399
1916.....	64,734,198	28,440,483	10,555,975	5,553,927	117,052,686
1915.....	46,318,804	26,220,000	11,098,815	3,854,106	93,049,981

Another factor to which the Lake Carriers' Association calls special attention in its annual report is the cordial relations which have existed between its members and the men who man the ships. As evidence of this, the association points out the largest registration ever known in the welfare plan, the cooperation which the men have given to the safety-first movement, the liberal amounts of their wage earnings deposited in the savings plan and the advantage they have taken of the opportunities to attend the free schools in navigation and marine engineering.

Wages

With a continuous season of navigation clearly in view when navigation opened last year, generous advances were made by the Lake Carriers' Association in the recommended minimum rates of wages for those aboard ship below the grade of licensed officers. Those whose rates of wages had been previously well adjusted received advances of $10 per month while in other grades advances of $22, $23 and $25 per month were made to bring them to parity. Notwithstanding the downward trend in ocean and coastwise rates of pay, which reached the point where Lake rates in 1923 were almost double those of sea pay, this wage scale continued in effect throughout the season.

The satisfaction of the men in the wage scale of 1923 was reflected by the steadiness with which they remained on one boat or in one employ, the turn-over of men manning the bulk freighters having been greatly decreased in comparison with preceding years.

Additions to the Lake Fleet

From all sources and for the several kinds of freight that make up the commerce of the Great Lakes, 70 additions were made to the fleet in 1923. Never before in the history of the Lake trade were so many vessels brought into the fleet

(*Continued on page* 184)

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Motorship Legislation Before Congress

Favorable Action on Edmonds Bill on Conversion of Ships to Motor Types Will Aid Shipbuilders and Operators

By "Old Scotch"

"SPARRING for an opening" might be used to describe the actions of the great political parties in Congress, if we can judge from their actions thus far in the session. Investigations of various activities of the government seem to follow one another in rapid succession, obviously for anticipated political advantage at the forthcoming Presidential election next fall. At the present writing it looks as if the much maligned Shipping Board is in for another investigation, the result of which will be to keep every one connected with the Board on the ragged edge while devoting their time to answering the thousands of questions, mostly irrelevant, which usually arise from such inquiries. No wonder we make but little progress with our shipping activities. For the past six years the members of the Board have largely devoted their time to waiting for appointments to be made, or in answering all kinds of questions propounded to them by investigating committees. The outcome is—nothing accomplished.

The Edmonds Bill

It is hard enough to keep ships running at all in these days of depression. Fortunately, however, there seems to be one ray of hope at this session and that is the probable passage of the Edmonds bill for the "Conversion of Ships into Motor Types." Ship operators and shipbuilders will both be benefitted by this measure if it is finally passed. On January 10 and 11, a comprehensive hearing on the bill was held by the House Committee on Merchant Marine and Fisheries. The bill as finally drawn was given the unanimous approval of that committee, which argues very well for its ultimate enactment. Members of both parties took part in the discussion and testimony was given by a number of representative ship and engine builders. Admiral Benson and Mr. Conti appeared on behalf of the Shipping Board, and submitted some very interesting and instructive data in support of the objects which it is hoped will be gained by the enactment of the bill.

The members of the committee who attended the hearing evinced a great deal of intelligent interest in the subject as indicated by their examination of the numerous experts called to testify. Mr. Metten of the Cramp Company, gave some interesting facts concerning the conversion of the *Seekonk*, a Hog Island vessel, recently completed by his firm. In fuel consumption he stated that the average of the type using steam was 29 tons per day whereas as a motorship the consumption was but 7½ tons per day. Her deadweight capacity for a given voyage was increased nearly a thousand tons and her engine room crew was six men less than formerly with steam drive. So far as the life of the oil engine is concerned, he stated that in the *Selandia*, one of the first motorships built eleven years ago, the engine is now "apparently as good as ever."

Cost of Converting Ships

One of the most interesting statements he made was that the cost of conversion of these ships in lots of ten, would be approximately 30 percent less than for a single conversion. For a new motorship he stated that the cost would be approximately 20 percent more than for a steamer of the same size and capacity. The much-mooted repair question was given attention by other experts and it seems to be agreed that the cost of repairs of a motorship would be 25 percent of the ordinary repairs on a steam vessel.

In connection with the matter of repairs and this testimony in particular, it is interesting to note the change which has come about. When motorships began to appear in American waters, it was the general belief that the repairs would cost more than for installations of the same power on steam vessels. The president of one of the largest repair plants on the Atlantic coast advised the writer five or six years ago that his men demanded 50 percent extra wage for working on motorships, owing to their being compelled to breathe the petroleum fumes arising from the cylinders after they had opened up.

Cost of New Motorships Abroad

As to the cost of new motorships abroad, the testimony was quite in agreement. Mr. Neeland, president of the New York Shipbuilding Corporation, stated that the latest quotation he had heard was from 11 to 13 pounds per deadweight ton. Mr. James Swan, editor of Marine Engineering and Shipping Age, who has but recently returned from the other side, expressed the opinion that the going price was from 14 to 15 pounds per ton. Mr. Wiltbank of the National Merchant Marine Association testified that as of June 30, 1923, there were 378,000 gross tons of new motor vessels building throughout the world. Of this 229,000 tons or 61 percent was building in Great Britain alone, whereas in the United States there were only 23,000 tons or 6 percent of the total building at this time.

Terms of Conversion Loan Fund

The bill, as finally reported, contains some interesting features. If passed, the construction loan fund may be utilized to convert Shipping Board tonnage into motor vessels, by both private owners and by the Emergency Fleet Corporation. Any vessel reconditioned under the loan fund must be documented under the laws of the United States and remain under such laws for a period of not less than five years and as much longer as may be necessary to pay off the entire amount of the loan.

Installments on the loan must be made at intervals not exceeding ten years, and in amounts of not less than 6 percent of the entire loan, may be paid off at any time within the fifteen years limitations of all loans, by simply giving the Shipping Board thirty days written notice.

In order to encourage foreign trade a very wise provision is included that if a vessel on which a loan is made is used exclusively in the coastwise trade the rate of interest shall be not less than 5¼ percent per annum and for such time as she may be used in the foreign trade the rate of interest may be reduced by the Board to 4¼ percent. Considering the prevailing private bank rates for capital borrowed on ships, this in itself is quite an incentive for American owners to embark in the foreign trade, where the competition is so keen, that every American vessel needs all the encouragement to be had.

The Board can only recondition with oil engines its own vessels for its own use, when they have made a binding contract for a satisfactory sale of such vessel, or for the charter or lease of such vessel, or for the charter or lease of such vessel for a period of not less than five years, to a

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capable, solvent operator. It may also recondition Board vessels if the Government itself is prepared and intends to directly put such vessel in operation as soon as it is completed.

The further restriction is made that the Board must keep these vessels documented under the laws of the United States for a period of not less than five years and during that period they shall be operated only on voyages which are not exclusively coastwise.

One very interesting clause in this bill is the fact that this is, so far as known, about the first time that Congress has ever been asked officially to fix the rate of depreciation on ship property. This has been a vexed problem which has confronted shipowners when paying taxes on their ship property. The Treasury Department officials have, on many occasions, fixed the depreciation on taxable ship property far below that which is warranted by the facts and below that which is generally accepted by private parties in dealing with floating property. The exact phraseology of the bill as reported is, "Provided further, that in fixing the minimum price at which the vessel may thus be sold the Board may deduct from the aggregate amount above described 5 per-centum thereof per annum from the date of the installation of the engine to the date of sale as depreciation." This is a wise and sensible provision, and one that is in keeping with general practice.

The chances for the passage of this measure are excellent. To those not familiar with Congressional procedure, it is often a matter of wonder why certain measures are not taken up and immediately passed.

The rules of the House are written so as to provide that all bills of this kind may be taken up for consideration at the proper time. This bill, having been regularly reported from the committee on Merchant Marine and Fisheries, is placed on what is known as the Union Calendar. Every other Wednesday is what is known as Calendar Wednesday, when the committees of the House are called in regular order. A committee which has reported no bill of this character is passed over and the next committee is called. At this stage of the session not many of the committees have reported bills and had them passed on the calendar. Hence when the turn of the committee on Merchant Marine arrives, it will be in order for the chairman of the committee to call up the pending bill; known as H. R. 5948. It can then be debated for ten whole days if necessary. As the report is unanimous it is hardly possible that the House will spend more than two or three hours in its consideration, as the committee has given it very careful consideration in all its phases before its report.

How it will be received and treated in the Senate is another story. Since the failure of the so-called Subsidy Bill in the Senate last year it is not wise to be too optimistic. From the present outlook, however, there seems to be no good reason why it should not receive the favorable consideration of that body. Let us hope so at least.

New Lake Steamers Have Largest Cabin Capacity in the World

THE new passenger steamers *Greater Detroit* and *Greater Buffalo*, which are now building in the yards of the Detroit Shipbuilding Company, Detroit, Mich., for the Detroit & Cleveland Navigation Company, are the largest in the world if the number of rooms for the accommodation of passengers is considered, said Frank E. Kirby, designer of the ships, who is now superintending the details of their construction.

The *Greater Detroit* and her twin ship the *Greater Buffalo* each contain 650 rooms for passengers with sleeping accommodations for 1,500 people, and there are rooms which provide space for 200 or more passengers who do not care to go to the added expense for berths. There are also accommodations for the crew which numbers 300. The *Leviathan*, one of the largest ocean passenger fleet, has only 571 rooms for passengers.

Carrying Capacity 50 Percent Greater Than Former Vessels

The *Greater Detroit* and *Greater Buffalo* upon their completion will be placed upon the run between Detroit and Buffalo. The new boats will have a carrying capacity 50 percent greater than the *City of Detroit III* and the *City of Cleveland III* now operating on the Buffalo run. The latter vessels will be placed on the Cleveland run, increasing the capacity on that division over 70 percent. The company proposes, if the new boats are completed in time, to establish a tourist line with the steamers *Eastern States* and *Western States* between Detroit, Mackinac Island and Chicago, but if delay occurs this project will be put off until another season.

Innovations Introduced

Many innovations have been incorporated in the room plans of the *Greater Detroit* and *Greater Buffalo*. All of the cabins de luxe are located forward of the machinery, and a large number of single berth rooms have been provided. All of the ocean passenger steamship lines have single berth rooms, but on the lakes, heretofore, passengers travelling alone desiring a room by themselves were compelled to purchase a two-berth room at considerable expense, and this practice in the past has resulted in seriously cutting down the passenger carrying capacity of the boats.

Passengers have complained at times that the brilliant lighting in the corridors of the boats reflecting through the ventilators into their rooms has been so bright that they were unable to sleep, and to obviate this difficulty foot lights have been placed in all the stairways and along the corridors and at bedtime all of the main lighting system will be turned out.

The smoking room in the new vessels is placed in the stern of the boat on the promenade deck, where it can be easily located by the passengers. It is a large airy room with closely placed windows sweeping in a great semi-circle from one side of the room to the other, affording an unobstructed view of the river and lake in all directions. No built-in seats will be placed in the smoking room, but a large number of chairs will be provided that the passengers can move about to suit their own pleasure.

Promenade Space Improved

Another innovation that will immediately attract the attention of old patrons of the Detroit and Cleveland Navigation Company's boats is the change Mr. Kirby has introduced in the promenade located on the boat deck—the highest deck on the boat where passengers gather during the trip down the Detroit river and when the boat enters Buffalo harbor. On the older boats the view is obstructed by a long row of life-boats, but on the new steamers all of the life-boats have been placed at the extreme after end, thus leaving the view entirely unobstructed at the forward end of the great steamers.

The Texas, where are located the quarters of the officers, is built above the boat deck and the pilot house is placed above the Texas. The bridge is high above the heads of the passengers standing on the boat deck and runs directly through the pilot house to the opposite side of the boat thus affording a direct path for the officer from one side of the boat to the other. The new bridge extends so far over the sides of the ship that the officer has an unobstructed view of his ship from stem to stern.

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Improving Conditions for Ship Officers

Secretary of Neptune Association Tells What Is Being Done by Organization for Shipmasters and Deck Officers

By Captain J. F. Milliken

BACK in 1910 a group of deep water and coastwise deck officers got together and decided that their conditions were not as they should be. They had discussed the various phases of their social and economic standing with the world at large and finally decided that somebody was to blame for the state of affairs as they existed at that time. After thinking the matter over carefully and after they had tried to get to the root of the evil, they finally very wisely placed the blame for their condition where it belonged—on themselves.

Days of the Clipper Ship

In the span of time between the golden age of American shipping, the clipper ship age, to the rather depleted days of our shipping in 1910, there had been a great change in the social and economic standing of our shipmasters and deck officers. The master of a ship was no longer the dignified skipper with his high silk hat, frock coat and silver headed cane. He no longer lived in the best house in his home town or travelled in the elite society patronized by his prototype. Somewhere a cog had slipped. The doctors, lawyers and other professional men had upheld the dignity and standing of their calling; they had advanced with the time and had willed to the younger generation everything they had learned and more.

The shipmaster, a member of a race apart, trained as he was to depend on himself and God, viewed with displeasure the rapidly changing course of events that followed the Civil War. He was not in sympathy with the new inventions or the new ways of doing business. He thought, dreamed and lived in the past and the industry that had been so creditably built up by his forebears was allowed gradually to fall behind the times. He grumbled about the conditions to himself and his officers; he complained about everything in general and did nothing for himself or his class and the oldest and most honored profession on earth, which had been placed in his sacred keeping in excellent condition, was permitted to become covered with barnacles and weeds. It became a water-logged hulk dragging alone some place in the wake of progress.

Not only had the profession become a derelict but the shipping industry itself had almost ceased to function as an American merchant marine. Only the history of the glorious days of the *Dreadnaught*, *Young America*, the *Flying Cloud* and other illustrious Yankee clipper ships, remained—only the history and one other thing, dignity, was left. The men who gathered together in 1910 decided that something was necessary for the well being of the American merchant marine and the standing of their profession beside dignity. The workers in other professions had profited by the example set by big business and had organized. Individual efforts had been set aside by the rapid advancement of machinery. Organization became a necessity in the industrial world.

The licensed masters and deck officers having finally placed the blame for their condition upon themselves, snatched a page from the book of progress and organized. They called their organization the Neptune Association of Licensed Masters and Mates of Ocean and Coastwise Steam Vessels and they named it wisely.

After the name it became necessary to write a declaration of purpose. Here it is just as it was written in 1910:

"The object and purpose of this Association is to unite into one great body the licensed masters and mates of ocean and coastwise steam vessels and thus enable them to demand and obtain a voice in the making of the laws and regulations under which they are governed; to improve the condition and status of the profession generally; to furnish assistance in professional matters, and at the same time to promote cordial relations with employers. Furthermore, that this Association be maintained as an entirely independent organization."

This expresses the ideas, the ideals, the reason for Neptune and it expresses them so well that it has never been considered necessary in the fourteen years of the existence of the Neptune Association to change even a line of the original thought.

The association was incorporated under the laws of the State of New York as a membership corporation in 1912. It has always maintained its integrity as an independent organization. From the time of its inception to the present day it has continued to bear the unique distinction of being the deep water man's organization. Practically every ocean going deck officer has sometime during his career been a member of the Neptune Association.

Scope of the Work of the Association

Neptune is and has been from the very beginning an association by the men, of the men and for the men. However, it has from time to time extended its services and support in other directions, including the families of its members, the steamship owners and operators and the government.

Seafaring Citizens Ask for the Privilege of an Absentee Vote

THE Neptune Association is endeavouring not only to arouse a greater interest in the American merchant marine, but also to induce seafaring men to have a greater interest in themselves. It is hoped to place the American merchant marine and the seafaring profession in the high place they once held—the finest in the world. Much can be accomplished through the ballot. The number of people vitally interested in the merchant marine who vote is much too small. The Neptune Association is at present working on a Bill that will soon be placed in the hands of Congress requesting the privilege of an absentee vote for American citizens who have chosen the sea for their vocation. Only by a concentrated effort through the polls by everybody interested in shipping can we hope to obtain and enforce legislation for the benefit of American shipping and the American citizens who go to sea.

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Some people might wonder how an association like Neptune could be of service to the government. Such people might be surprised to learn that on practically every government committee formed in connection with shipping there has been a member of the Neptune Association. This has been done at no expense to the government. These men have offered their services and practical advice, founded upon years of experience in shipping problems and legislation needs.

In the late World War almost eight thousand members of the association were sailing through the war zone, carrying troops and supplies to France, England, Russia and our other allies. Over 2,000 members were commissioned in the Navy as ensigns, lieutenants and commanders. One hundred and two of them made the supreme sacrifice and at the present time hundreds of members are scattered throughout the country in various hospitals suffering from tuberculosis, loss of limbs and other ailments—seafarers broken by the war eking out their remaining days ashore.

People are sometimes surprised to learn that so many Neptune men were commissioned in the Navy. These same people will probably be more surprised to learn that the principal features of the present Naval Reserve Bill were first discussed in the offices of the Neptune Association. Other organizations of seamen have been opposed to a naval reserve but the Neptune Association has always vigorously supported this very necessary branch of our national defense.

Members of the association also bring back, from time to time, various data on ocean currents and the changes in foreign ports, which are tabulated by the Hydrographic office and used by the Navy in constructing charts and for other purposes. In numerous other ways the men have been of value to the Government.

Strange as it may seem to some people, they have also been of value to the steamship owners. The association has assisted the private companies. Neptune has always maintained a free employment department—free to the company and free to the men. It has always been willing to support every measure that, in the opinion of its members, was of benefit to the American merchant marine. The late Ship Subsidy Bill was vigorously supported by Neptune. The association came out strongly for this aid to American shipping when other bodies of seamen wanted to barter with the owners before giving their support to this bill. Neptune had the satisfaction of seeing all the organizations of officers follow its example. It was during this time that the Marine Engineers Beneficial Association became involved in a controversy with the American Federation of Labor, which ultimately resulted in the M. E. B. A. withdrawing from the federation.

Raising the Efficiency of Members

Some time ago the association adopted a slogan that "The Best Men are Neptune Men." Through *The Neptune Log* and in other ways, the officers of the association have urged their members to make this slogan a fact. They have stated time and again that if there is only one Neptune man on a ship he should be the best man. If one ship of a fleet was completely officered by Neptune men, that ship should be the most efficient and economically operated ship in the fleet and this work has borne fruit for at the present time members of the Neptune Association rank as the very best officers in our merchant marine.

The general public has also profited by the work of the Neptune Association. In its efforts to furnish the merchant marine with a better class of deck officers it has made ocean transportation safer for the travelling public and the shipper. When times were good and conditions in the association were prosperous, no person in need of aid was ever turned away from the doors of Neptune Association empty handed. The Red Cross, Salvation Army and other national institutions of like character; homes for old men, old women, orphans and invalids, were generously supported from the funds of the association.

While there is no benefit attached to the Association, dependents of members who have been found in need have been generously taken care of in various ways and many a widow of a deceased seaman has written her letter of appreciation to the officers of the Neptune Association for the assistance they have rendered her in time of need.

Improving Conditions for Officers

Being an organization for the members, the greatest work of the association has been done for the licensed masters and deck officers of the American merchant marine. The Neptune Association very actively supported the "Three Watch Bill," which called for three watch officers on every vessel in place of two. The three watch system made it possible for the watch officers to stand a four hour watch instead of six hours, which was formerly required. In addition to this, it has from time to time, arranged for scales of pay and committees have brought out various reasons why the men should receive more money. Such reasons were never veiled with threats of strike but were based on sound argument and presented in such a convincing manner that the steamship owners and the Shipping Board have from time to time granted to the men additional pay.

During the past year, the Neptune Association has worked hard to better the conditions of the officers on merchant vessels and to raise the standard of the personnel of the American merchant marine. Early last year a substantial increase in pay for the officers on the government passenger vessels was obtained and the association entered into an agreement with the Shipping Board on July 1, 1923, whereby the men on the freight vessels received a straight $20.00 per month increase in pay.

The last Neptune committee that went to Washington to discuss wages and working conditions with the Shipping Board were able to convince the members of the board that it was not fair to the officers to discharge them any place in the United States without making arrangements to pay their fare back to the home port. Previous to this agreement many officers had been shipped on the Atlantic seaboard and had been discharged on the Pacific coast and it cost them more money to get back home than they earned on the entire voyage. In a number of cases the families of these men, who depended on the earnings of the officer, were left in straightened circumstances and on many occasions the members of the association dug into their pockets to make a collection for the men, or their families.

Untold Sea Tales to be Published

In addition to this, the association has been gathering stories for a book which will be known as "Untold Tales of the Sea." Such men as William McFee, Bill Adams, Felix Riesenberg, Arthur Lockwood, Alexander Corkum, G. McPherson Hunter, Lincoln Colcord and other well known writers, all of whom are seafarers, have contributed stories. In addition numerous other stories have been written and contributed by the rank and file members of the association. The profits from this book will be applied to a fund to aid the widows and orphans of sea-faring officers.

An effort to repeal the sixty-day time limit for admission to marine hospitals has been made and also a request made that a special ward be set aside for the officers of the American merchant marine in these hospitals. An appeal was made to place a merchant marine master in command of the steamship *Leviathan* when it was generally understood that an ex-naval officer would be appointed to command this ship. Special courses have been arranged at Columbia University for the men so that they can improve themselves and thus raise the standard of the personnel. A protest was made by

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Influence of Size on Operating Expense of Motorships

By L. B. Chapman

Below is given an operating cost comparison between six typical motorships with the idea of determining a practical method for arriving at the size of the most economical ship. Because of the fundamental differences in the ships, in the service which they perform and the variance in length of voyage, the value of the article is mainly in showing tendencies rather than in developing a hard-and-fast rule for determining the best ship for a given service to the exclusion of all others. Every effort has been made to change the data and characteristics of the six motorships taken so that they will at least be comparable.—THE EDITORS.

A STUDY of the merits of large and small cargo ships on a given trade route shows that both the large and small ship have certain advantages and disadvantages. These may be summed up briefly as follows:

Advantages of small ship

1. Small initial investment.
2. Can enter smaller harbors.
3. Can obtain a full cargo more readily.
4. Less overhead loss when idle.
5. Faster rate of loading per day per ton of cargo.

Advantages of large ship

1. Smaller crew carried per ton deadweight.
2. Less shaft horsepower per ton deadweight. (Power varies as the two-thirds power of the displacement.)
3. Less fuel used per ton-mile.
4. Smaller initial cost per ton of deadweight.
5. More cargo carried per trip.
6. Less wear and tear on propelling machinery due to fewer trips per year.

COMPARISON OF TYPICAL MOTORSHIPS

In order to investigate the influence of the size of a ship on the annual operating expenses, the following systematic comparison has been worked up for six motorships for a voyage of 5,000 miles: The ships vary in size from 4,700 tons gross deadweight to 15,000 tons gross deadweight. The characteristics of these six ships have been fixed in such a way that as many factors as possible may be kept constant. The characteristics that have been varied from ship to ship have been changed in as systematic a manner as possible so that the results will be comparable. This method of analysis has of course given ships that do not have the best characteristics for all sizes. Thus, for instance, 11 knots is probably too high for the smaller ship and twin screws are not so advantageous as a single screw for propulsion in the small ships.

The particulars of the six ships are given in Table I. It will be observed that the beams used for some of the ships are somewhat larger than existing practice, but this was done in order to get the best all around ship for comparison. A block coefficient of 0.78 has been used for all six ships. The gross deadweight was obtained from the displacement by subtracting the sum of the hull and machinery weights given in Table I. The total weight of machinery per shaft horsepower has been increased slightly as the horsepower decreased in the smaller ships. The net tonnage used is only an approximate value and was estimated from existing ships. The shaft horsepowers have been carefully calculated from model tank data and Taylor's propeller efficiencies. The costs of the ships have been assumed as closely as possible to existing practice. Costs will always be open to some criticism because of the wide variation in costs of Diesel machinery. *The data and results presented here are not intended to be exact in every case, but every effort has been made to change the data and characteristics systematically from ship to ship so that the results will be comparable.*

In addition to the data given in the table the following conditions were assumed for the comparison:

1. Ships operating at 80 percent load capacity.
2. Four cycle Diesel engines.
3. Twin screw installations: 115 revolutions per minute.
4. Electric engine room auxiliaries and electric deck machinery.
5. Fuel $13.50 per ton and 7.35 pounds per gallon.
6. Cargo handling based on a working day of 10 hours.

The number of winch and boom systems has been varied with the size of ship. Practice today varies widely both in the installation and use of these systems. Some ships have more installations than those given, but probably the majority of the larger ships have fewer systems than used in this comparison. In one case where one of the holds was small, this hold was assumed to be unloaded or loaded in less time than the larger holds. This accounts for the hatch hours per day for ship number 5 (line 18, Table I) being less than 10 times the number of hatches. In actual practice, of course, these holds would be worked a full day the same as the larger holds, but they would be emptied or loaded sooner and then the winch system would be idle. The net result would be the same as the method employed here. The data in line 19, Table I, was estimated by using a constant

TABLE I

Particulars and General Data for Motorships 5,000-mile voyage at 11 knots

		Ship No. 1	Ship No. 2	Ship No. 3	Ship No. 4	Ship No. 5	Ship No. 6
1.	Length B. P.	500	480	420	390	375	325
2.	Beam	68	63	60	57	55	47'-6"
3.	Molded depth	41'-0"	36'-8"	35'-0"	32'-0"	31'-3"	26'-9"
4.	Load draft	29'-6"	27'-0"	26' 0"	24'-6"	24'-0"	21'-0"
5.	Load displacement (block coef. = .78) tons	22,400	17,050	14,600	12,150	11,000	7,220
6.	Gross deadweight (tons)	14,960	11,350	9,695	8,050	7,270	4,675
7.	Net tonnage	8,300	5,500	4,700	3,800	3,300	2,000
8.	Model EHP+ 10 percent	2,370	1,950	1,760	1,550	1,450	1,130
9.	S.H.P. (calculated for trial speed of 11½ knots)	4,080	3,280	2,910	2,540	2,360	1,800
10.	Weight of hull (tons)	6,400	4,850	4,150	3,430	3,100	2,040
11.	Machinery weight (tons)	1,040	850	755	670	630	505
12.	Stores, provisions and fresh water for 5,000 miles (tons)	60	55	50	50	45	40
13.	Fuel for 5,000 miles + 20 percent reserve (tons)	438	352	312	272	253	193
14.	Total cost of ship	$1,620,000	$1,300,000	$1,140,000	$970,000	$900,000	$590,000
15.	Days lost per year	27	25	24	22	20	18
16.	Port fuel (tons per day)	1.2	1.1	1.0	0.9	0.8	0.75
17.	Number of winch and boom systems installed	8	7	6	6	5	4
18.	Number of hatch-hours per day	80	70	60	50	45	40
19.	Tons of cargo handled per hatch per hour	26	28	29	30	31	32.5
20.	Total cargo handled per 10 hour day (tons)	2,080	1,960	1,740	1,500	1,390	1,300

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TABLE II

Operating Expenses for a Voyage of 5,000 miles (80 percent deadweight capacity)

		Ship No. 1	Ship No. 2	Ship No. 3	Ship No. 4	Ship No. 5	Ship No. 6
1.	Gross deadweight (tons)	14,960	11,350	9,695	8,050	7,270	4,675
2.	Cargo deadweight (tons)	14,462	10,943	9,333	7,728	6,972	4,442
3.	Speed in service (knots)	11	11	11	11	11	11
4.	Fuel per s.h.p. per hour (pounds)	.44	.44	.44	.44	.44	.44
5.	Fuel per hour at sea (pounds)	1,795	1,440	1,280	1,115	1,037	792
6.	Days on run at 11 knots sea speed	18.95	18.95	18.95	18.95	18.95	18.95
7.	Calculated time in port + 10 percent	12.25	9.85	9.45	9.05	8.80	6.90
8.	Days per single trip	31.20	28.80	28.40	28.00	27.75	24.95
9.	Single trips per year	10.82	11.80	12.00	12.25	12.43	13.90
10.	Tons of cargo carried per year	125,300	103,500	89,500	75,700	69,500	49,400
	Annual Expenses						
11.	Depreciation 5 percent	$81,000	$65,000	$57,000	$48,500	$45,000	$29,500
12.	Insurance, hull and machinery 5 percent	81,000	65,000	57,000	48,500	45,000	29,500
13.	Maintenance, overhauling and repair reserve	51,000	35,000	32,000	27,000	25,000	20,000
14.	Total capital charges	$213,000	$165,000	$146,000	$124,000	$115,000	$79,000
15.	Fuel oil at sea and in port at $13.50 per ton	$55,400	$48,460	$43,800	$38,860	$36,500	$31,100
16.	Lubricating oil at 75c. per gal	5,000	4,500	4,000	3,600	3,300	2,900
17.	Wages of crew	44,400	41,200	39,700	39,700	39,700	36,600
18.	Subsistence of crew at 70c. per man per day	11,500	10,500	9,700	9,700	9,700	8,200
19.	Tonnage dues and port charges	55,000	38,600	35,000	30,000	27,000	18,700
20.	Brokerage and management at 70c. per ton	87,800	72,500	62,500	53,000	48,600	34,600
21.	Stevedoring at $1.00 per ton	250,000	207,000	179,000	151,400	139,000	98,800
22.	Annual operating expenses (no profit)	$721,800	$587,700	$519,700	$450,200	$418,800	$309,900

time for hooking the draft on and off and varying the time of hoisting slightly with the depth and beam of the ship.

The daily rates of cargo handling given in line 20 are higher than the general practice today, especially for the larger ships. As the main object in this comparison is to make all the data used consistent and comparable, the cargo handling rates have been increased systematically with the size of the ship. The length of the working day used, on the other hand, is probably shorter than general practice today. The rate per hatch per hour or the number of hatches in operation can be readily reduced and a longer working day used. Thus for ship number 3, if a rate 20 tons per hatch per hour is used instead of 29 tons, and 5 hatches are in operation, instead of 6, a 17½ hour day would be required to maintain the daily speed used in line 20. The influence of changes in rates of cargo handling is given for ship number 2 at the end of the article.

Annual Operating Expenses

The annual operating expenses are summarized in Table II. The method of calculating these has been described by the writer in the January, February and March 1923 issues of Marine Engineering and Shipping Age, and need only be described here briefly. The shaft horsepowers as shown in line 9 of Table I have been calculated with a 10 percent margin for a trial speed of 11½ knots. These same horsepowers are allowed in service for a speed of 11 knots (line 6, Table II). The weight of cargo carried per trip was obtained by calculating the stores and fuel oil for a voyage of 5,000 miles and then allowing a reserve fuel weight of 20 percent. The port fuel for operating the winches and lightering has been estimated from motorship practice and increased from ship to ship directly with the weight of cargo handled.

Repair and Port Time

The days lost per year have been chosen arbitrarily. This allows for docking and annual overhauling, repairs, and general delays. It has been assumed that the larger ships would require a longer time at the annual overhauling and that they would also lose more days per year due to delays caused by cargo.

The time spent in port varies directly with the amount of cargo carried (line 2, Table II), and the daily rate of cargo handling (line 20, Table I). The tonnage dues and port charges include: Pilotage, towage, cooperage and dunnage, clerks, watchmen and miscellaneous fees; wharfage at two cents per net ton per day; and tonnage dues averaged at 20 cents per net ton. An increase of 10 percent over the calculated time has been added as a margin and to allow for delays caused by tides, etc.

The annual expenses are tabulated in Table II and need little explanation. The wages of the crew are all based on the United States Shipping Board scale of April, 1922, which was used in the articles by the writer in his series of articles in Marine Engineering and Shipping Age in 1923. Changes can readily be made in any of the items of the operating expenses where data is at hand different from that used.

Summary of Data

The data presented in the summary in Table III is very interesting. The calculations show that the optimum size of ship for the assumed conditions is the 450-foot ship of 11,350 tons deadweight (ship number 2). Ships larger or smaller than ship number 2 show a smaller profit for a given freight rate (line 2, Table III), the profit decreasing with the change in deadweight.

It will be observed in Table III that the initial cost per ton deadweight, annual cost of crew and subsistence, cost of fuel per ton-mile all vary inversely as the size of the ship, increasing as the deadweight is decreased. As the deadweight varies directly with the displacement and the power for similar ships varies as the two-thirds power of the displacement at low speed-length ratios, the shaft horsepower per ton deadweight, and consequently the fuel consumption per

TABLE III

Summary

		1	2	3	4	5	6
1.	Cargo rate per ton to give 10 percent profit	$7.06	$6.95	$7.09	$7.25	$7.32	$7.46
2.	Percent profit at $6.95 per ton cargo (percent)	9.15	10.0	9.0	7.9	7.1	5.75
3.	Cost per gross deadweight ton	$108	$115	$118	$120	$124	$126
4.	Cargo deadweight per S. H. P. (tons)	3.54	3.34	3.20	3.04	2.96	2.46
5.	Annual cost of crew and subsistence per ton cargo deadweight	$3.87	$4.65	$5.40	$6.53	$7.09	$10.10
6.	Cost of fuel per 1,000 cargo ton-miles traveled (cents)	8.85	9.35	9.80	10.3	10.5	12.6
7.	Annual operating cost per 1,000 cargo ton-miles	$1.20	$1.14	$1.16	$1.19	$1.21	$1.25
8.	Rate of stevedoring per 10-hour day ÷ net deadweight (tons)	0.144	0.18	0.187	0.194	0.20	0.292
9.	Percentage of year spent in port loading and unloading cargo (percent)	36.4	31.8	31.0	30.3	30.0	22.8
10.	Overhead per day, including crew and interest rate of 6 percent on investment	$1,000	$810	$725	$635	$600	$435

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ton deadweight, increase as the size of the ship decreases.

The rate of stevedoring per ton carried (line 8) is higher for the smaller ship than for the larger ship. This is due both to the smaller hold volume per hatch and to the faster rate per hatch which is theoretically possible with the smaller ship.

Line 9, Table II shows that the smallest ship (number 6) makes 13.9 single voyages per year against only 10.8 voyages for the largest ship (number 1). Despite this fact the larger ship carries more cargo per year and pays a larger profit due to the greater cargo carried per voyage.

CONCLUSIONS DRAWN FROM COMPARISONS

The foregoing comparison is not intended to prove that any particular size of ship is more favorable than any other size as indicated in Table III. Changes in the length of trade route, the speed, type of machinery, rate of cargo handling, hatch arrangements and percent of deadweight carried, will all influence the results and give a different optimum ship. *A change in the number of winch-boom systems or the rate of cargo handling for any ship will change the earning capacity of that ship and thus change the relative order in the above comparison.* The comparison does indicate the influence of size of ship on operating expenses and points out some of the governing factors.

VALUE OF COMPARISON

The real value of this comparison, in the opinion of the writer, is the influence that the rate of cargo handling has on ship operation. The comparison shows that the largest ship does not bring the same return on the investment that ship number 2 does, despite the advantages gained by increased deadweight (lines 3, 4, 5, 6 and 7, Table III). In line 9, Table III the percentage of the year spent in port has been recorded for each ship. It must be remembered that a ship is built primarily for carrying cargo from one port to another and consequently it is not earning profit when tied up in port.

The foregoing calculations show that, even with the apparently high rates of cargo handling used, the largest ship is in port 36 percent of the year. During this time the large overhead expenses consisting of insurance, depreciation, interest, maintenance, crew expense, wharfage, etc., are piling up. With an interest rate of 6 percent allowed on the investment, the overhead per day as shown in line 10, Table III, amounts to $1,000 for the largest ship against $435 for the smallest. Thus the largest ship with over twice the overhead of ship number 6 is detained in port twice as long for handling cargo. The foregoing analysis indicates clearly that the large ship is at a great disadvantage because of the slow turn-around caused by the low rate of cargo handling. If large ships are to be used, it is imperative that faster rates of handling cargo must be used than those prevailing today, provided of course, that sufficient cargo is available for a quick turn-around and more voyages per year.

FASTER HANDLING RATES FOR CARGO

A faster cargo handling rate can be obtained by adopting a longer day, installing more winch and boom systems, using a faster rate per hatch, or by a combination of all of these factors. If ship number 1 were fitted with 12 winch systems instead of 8 and an 18-hour day were used instead of a 10-hour day, with 30 tons per hatch per hour, the daily rate would be 6,500 tons. This rate is three times that allowed for ship number 1 under the conditions assumed for the comparison. Although the above speed of handling cargo may seem highly improbable it is not impossible, for the separate factors making up the rate already exist. Ships of this size (the steamship *Andrea Luckenbach* for example) are fitted with 12 winch systems, the 22-hour day is used to some extent and rates higher than 30 tons per hatch per hour have been recorded, although they are not common. The writer has observed rates on sugar cargoes where the rate was 70 tons per hatch per hour. (See article by the writer in MARINE ENGINEERING AND SHIPPING AGE for November, 1920).

With the above rate of 6,500 tons per day, ship number 1 would be in port about four days per voyage and make nearly 15 trips per year instead of 11. This would give a return of 20 percent instead of 9 percent on the investment for a cargo rate of $6.95 per ton.

In order to determine the most economical ship for a 5,000 mile voyage, speed and type of machinery must be considered as well as size and rate of cargo handling. All these factors have been treated by the writer in recent articles in MARINE ENGINEERING AND SHIPPING AGE. As pointed out in the July, 1923, issue, a speed of 11 knots is too high for best economy and if economy alone is considered 9½ to 10 knots would be better than 11 knots.

If the length of voyage is changed the size of the ship would also change and a smaller ship would be called for on the shorter voyage because of the greater percentage of time spent in port.

It should be realized that such general comparisons as the above can only be made in a somewhat theoretical manner by assuming certain factors constant and others variable. A true solution for the most economical ship for a given trade route can only be made after all operating data and actual experience for the route in question have been brought together. Type of machinery, size of ship, speed, rate of cargo handling, amount of cargo available and percentage of load capacity carried per trip must all be considered together and cross curves drawn in order to determine the actual optimum ship.

Improving Conditions for Ship Officers

(*Continued from page* 142)

the Neptune Association against the long hours of duty. Many companies that worked the sailors eight hours a day were expecting an eighteen hour day from the second and third mates. This condition was corrected by some companies through the efforts of the association. Several people were arrested in New York for crimping on the strength of evidence which was placed before the Shipping Board by members of the Neptune Association. Many members in distress were assisted in numerous ways.

ACTIVITIES OF THE ASSOCIATION VARIED

A great many men who were placed on the Shipping Board deferred employment list on the strength of a false or mistaken report were defended and cleared by the officers of the Neptune Association. Many members were placed in good positions aboard steamers and Neptune was probably the only organization of deck officers that shipped masters during the past year. Through the association many mates were shipped, especially in oil tankers. Questions involving pay were straightened out and carfare was obtained for many members who shipped in one port and who were laid off in another through no fault of their own.

It can be said without fear of contradiction that the Neptune Association has done more for the masters and licensed deck officers of the American merchant marine than all the other organizations combined.

The Neptune Association is constantly making an effort to raise the standard of the officers of the American merchant marine, to cooperate with the various branches of the industry, to promote favorable legislation for American shipping and its members and to foster a fraternal spirit among the officers of the merchant marine. The work of this association is worthy the support of everyone who has the real interest of the merchant marine at heart.

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British Shipowners Consider Future of Diesel Engine

First Cost of Diesel Engines Reacts Against Adoption—Comparison of Operating Costs Between Diesel and Steam Engined Ships — Government Aid Under Trade Facilities Act

By W. H. Wendon

SHIPOWNERS and shipbuilders throughout the United Kingdom continue to display the liveliest interest in regard to the question of the future of Diesel engines as compared with other types of propulsion. The great majority of the experts remain remarkably coy in the matter of their experiences and views on this vital subject, but in at least one notable instance a lead has been given by an acknowledged authority; nor does the Diesel engine suffer at his hands.

Sir Fortescue Flannery, whose views I am quoting, unfolded them in the course of his presidential address to the Junior Institution of Engineers and, briefly, they are as follows: He knows of a recent case in which owners, in the final result, decided to go in for steam engines owing to the considerably higher first cost of Diesel engines. It seems to Sir Fortescue Flannery that owners sometimes attach undue importance to initial cost when weighing it against gains in operation. He cites as a case in point that of a 9,000-ton deadweight vessel to do, say, 10½ to 11 knots in service. A Diesel ship conforming to these requirements would cost about £25,000 more than a steamer. Leaving out of account all gains from increased deadweight and/or capacity, and the gains attaching to a quicker despatch of the steamer in any bunkering operations, and assuming that the wages and victualling of the engineering personnel are the same in each case (there is, as a matter of fact, says Sir Fortescue Flannery, a substantial saving on wages and victualling in the Diesel boat), the steamer would use 10,000 tons of coal per annum and the Diesel vessel 2,500 tons of oil. These calculations are confined to the fuel bill alone, the assumption being that the vessels put in 250 days at sea per annum. The average price of bunker coal, taking 23 representative ports in the world, was recently £2 0s. 4d. per ton. The average price of Diesel oil, taking the same ports, was £3 17s. 8d. per ton. On that basis the annual fuel bill of the steamer would be £20,166, and that of the Diesel ship £9,521 —a saving of £10,645. This represents a return of over 42 percent on the additional capital invested in the Diesel boat on the fuel item alone. "Does that not sound," Sir Fortescue asks, "a good enough investment?"

Influence of Machinery on Operating Costs

Diesel ships also figure largely in observations made by Mr. W. G. A. Perring, in the course of a paper on "The Influence of Type of Propelling Machinery on the Running Costs of Ships." He bases his calculations on a vessel of 9,220 tons displacement, with a speed of 10¾ knots and gives an analysis of costs when such a vessel is propelled by all the types of engines in common use. The analysis shows, for example, that the coal-fired ship could compete successfully with the oil-burning ship provided that the price of coal was approximately half that of boiler oil. It would appear that for short trips it was more profitable to use oil, but in long ocean voyages, where large quantities of fuel were involved, the coal-burning ship became a better paying proposition, although suffering from the point of view of cargo deadweight.

Mr. Perring thinks that the actual range for which the oil-burning boat is more profitable is not well marked, but that for voyages of over 3,000 miles the coal-fuelled ship has the advantage in every type of steam machinery considered. This, of course, is with the reservation respecting fuel prices per ton. With boiler oil at 30s. a ton (the same price as that assumed for coal), the oil-fired ship is computed to be "very much superior." It would be noticed, the analysis proceeds, that it was only on extremely long voyages that the Diesel ship possessed any advantage over the steam. This was mainly on account of the higher first costs.

A difference would be seen in the case of the Diesel-electric, which, for voyages of 3,000 miles and upwards, showed a marked superiority over all other types of drive. Its advantage for the shorter voyages over the other motorships was because of the lower fuel consumption assumed for the electric auxiliaries while in port; for the greater length voyages it was first cost alone that enabled it to run more profitably. Finally, Mr. Perring declares that the problem of obtaining the absolute "best" ship for any trade is next to impossible of solution. "It depends so much on prices that were never fixed, consequently causing the size or speed to fluctuate with the fluctuation of conditions to be met."

Diverse Views of Operators on Engine Question

Two interesting examples of the opposing views held by shipping companies are provided in the case of the Houlder Line, Ltd., and the Court Line, Ltd., both of London. The Houlder Line, which is associated with Furness, Withy & Co., Ltd., and Houlder Brothers & Co., Ltd., is considering, in connection with its decision to order a 10,000-ton vessel, the desirability of installing Diesel engines in the new boat. On the other hand, the Court Line, a successful cargo boat concern, for whom two new steamers will be delivered this year, have not yet ordered any Diesel-engined ships, as the directors are not certain that for tramps they are the best type of engine. The remarks of the chairman of the Company (Sir Laurence Philipps) indicate pretty clearly the feeling of the board. He states:

"Diesel engines undoubtedly show certain advantages over the steam engine, but for a tramp steamer, which runs all over the world and which might not be able to get renewals when wanted, a difficulty might arise. Besides, the reliability of the Diesel engine has not been proved over a long period of years like the steam engine has.

"You get twenty years' life out of a steam engine, the condition then being, to all intents and purposes, as good as when new if properly looked after. Also, the initial expense in the case of the Diesel is much greater. In our case it would be about £40,000 more, and we should have to provide depreciation for that over the life of the steamer."

The Trade Facilities Act

There has been much misconception and confusion, both in the United Kingdom and elsewhere, in regard to the working of the Trade Facilities Act, with particular reference, of course, to the grants to shipping companies for the construction of new tonnage. It is now possible, however, to place the matter clearly before all interested. In the first place, the treasury guarantees the money, all of which has to be repaid, so that it is by no means a gift, as seems to be the impression in some quarters. Several of the most reputable British shipping lines have, as already recorded, availed themselves of the facilities which the measure offers, the most recent sums guaranteed being, at the moment of mailing, the following: Atlantic Transport Co., Ltd., London, £400,000

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(construction of ship at Belfast); Anchor-Donaldson, Ltd., Glasgow, £400,000 (completion of ship already partly built); Bellailsa Steamship Company, £37,000 (construction of ship at Port Glasgow); Waverly Shipping Company, Glasgow, £37,000 (construction of ship at Port Glasgow); and Grahamston Shipping Company, Glasgow, £20,000 (construction of ship at Burntisland). These guarantees are not confined to the liner companies, for the Trade Facilities Act Advisory Committee are prepared to look with a favorable eye on any applications for guarantees in connection with new tramp tonnage, subject to the following terms and conditions:

(1) The application for a guarantee to be, say, 50 per cent of the cost of the ship.
(2) That the owners give reasonable proof that they know their business.
(3) That the remaining cost of the ship is supplied by share capital.
(4) That the necessary working capital is put up on shares.
(5) That the managers undertake not to draw any remuneration in any year unless and until the interest and sinking fund on the loan had been paid.
(6) The loan to be for a period of ten years, being repaid by installments over that period.
(7) The security to be a first mortgage on the ship.

The confusion which has arisen comes from the belief that the British Treasury will provide guarantees for *foreign* owners. This, however, is not the case.

DUTCH ORDER SHIPS FROM FOREIGN YARDS

The placing of orders for new tonnage by Dutch steamship owners with yards outside their own country has been followed by a storm of protest. There are two particular instances: (1) the ordering of a 5,600 ton cargo steamer by the Rotterdam firm of Erhardt and Dekkers from the Clyde Shipbuilding Company, Glasgow, and (2) the placing of a contract, by the Nederland Company, with the St. Nazaire (France) Ateliers and Chantiers de la Loire, for the construction of a motor passenger steamer, 520 feet in length. The ordering of these boats abroad has come as a profound shock to Dutch shipyard people, who, for some long time, have been able to withstand all competition from at least United Kingdom shipbuilders.

The question of taxation, coupled with restricted working hour regulations, seem to have brought about the failure of the Dutch yards in the case of the British-built boat. As regards the contract with France, however, very exceptional circumstances appear to have ruled, the main reason for the cheap tender handed in being that the yard was able to purchase, at an extremely low cost, a vast quantity of raw material.

Apropos, French shipbuilding in general, some interesting details are gleaned of a rather remarkable incident which has just taken place. Two British builders competed for a certain job, and, in order to secure the contract, cut their prices to such an extent that there was the smallest of sums between them. As a matter of fact, the contract went to a French yard, whose tender was as much as £22,000 below that of the lowest British figure. This vast difference in cost is understood to be due to the fact that the French Government gave the builders the steel at a very low price in order to enable them to secure the job. The views of United Kingdom shipping people on this little French "subsidy" incident are not complimentary to French official quarters.

COMPETITION BETWEEN EUROPEAN SHIP OWNERS

Competition, but purely of a shipowning character, is involved in an interesting discussion now taking place between Britain, France, Belgium and Germany. Briefly, it is suggested in responsible French shipping circles that there should be joint political action with Belgium in order to check the progress of German shipping competition and it is at least significant that the French Government approves the suggestion. The hope is expressed in France that Great Britain will eventually join in the proposed concerted action, the foundation for this hope being, apparently, a speech delivered to the shareholders of one of the principal British shipping lines by their chairman, a leading shipowner and an ex-president of the Chamber of Shipping of the United Kingdom.

French shipping interests would appear, however, to have drawn wrong conclusions from the remarks made by this authority, for, while he concerned himself with the taxation of German exports for reparation purposes, holding that if German industries are to be treated in that way for the benefit of the Allies the earnings of German shipping should be regarded as an export and treated accordingly, the French suggestion above referred to proposes that the Germans should be forced to place at the disposal of the French shipping companies in German ports suitable berths, presumably free of charge or at reduced rates. It is also suggested that they should be compelled to ship a certain tonnage of merchandise at a given price in French vessels. To sum up, there is a strong feeling in United Kingdom shipping circles that, while Germany should be called on to make all reasonable amends for wartime actions, these should be carried out on normal lines, and that German ships should not be placed at a disadvantage in their own or in other ports.

New Bethlehem Oil Engine Tested In Motorship Cubore

THE motorship *Cubore* had a successful trial trip in Chesapeake Bay on February 8, 1924. This vessel, built by the Bethlehem Shipbuilding Corporation, as an ore carrier, was originally fitted with what may be termed an experimental Diesel engine and the data and experience gained from this first engine have been embodied in the perfected machine now fitted on the *Cubore*. Judging from the trial results, the time and money spent in experimenting were well invested, for the Bethlehem Company now evidently has a dependable engine of the highest class.

The engine is of the two cycle single acting type, having air injection and combined valve and port scavenging. Among the many points of interest presented by the design, possibly the most important is the cylinder cover arrangement, the combination of fuel and scavenging valves making possible a symmetrical design, and minimizing the danger of cracks and heat strains.

The auxiliaries are entirely electrically driven, power being furnished by three McIntosh & Seymour Diesels.

The electrical arrangements are complete and have been worked out and the various items of equipment supplied by the General Electric Company.

The method of electric control applied to the cargo winches and the automatic electrical mooring winches for maintaining a constant strain on the mooring lines are of particular interest.

The ship performed very satisfactorily on trial, maneuvered easily and quickly and the almost entire absence of vibration was very noticeable.

The following information, relative to the grade of fuel oil used during the trial is of interest. Before the dock trial, 34,000 gallons of 25.7 degree Baumé oil were run into one of the ship's fuel tanks. The dock trial was run on this oil after which 76,000 gallons of 19.5 degree oil were run into the same tank. It will be seen that the river trial was thus run on a mixture of oils, having a mean of about 21 degrees Baumé.

We publish elsewhere in this issue a complete description of the Bethlehem-Diesel engine to be followed by a description of the automatic mooring winch and other details above mentioned, in a later number.

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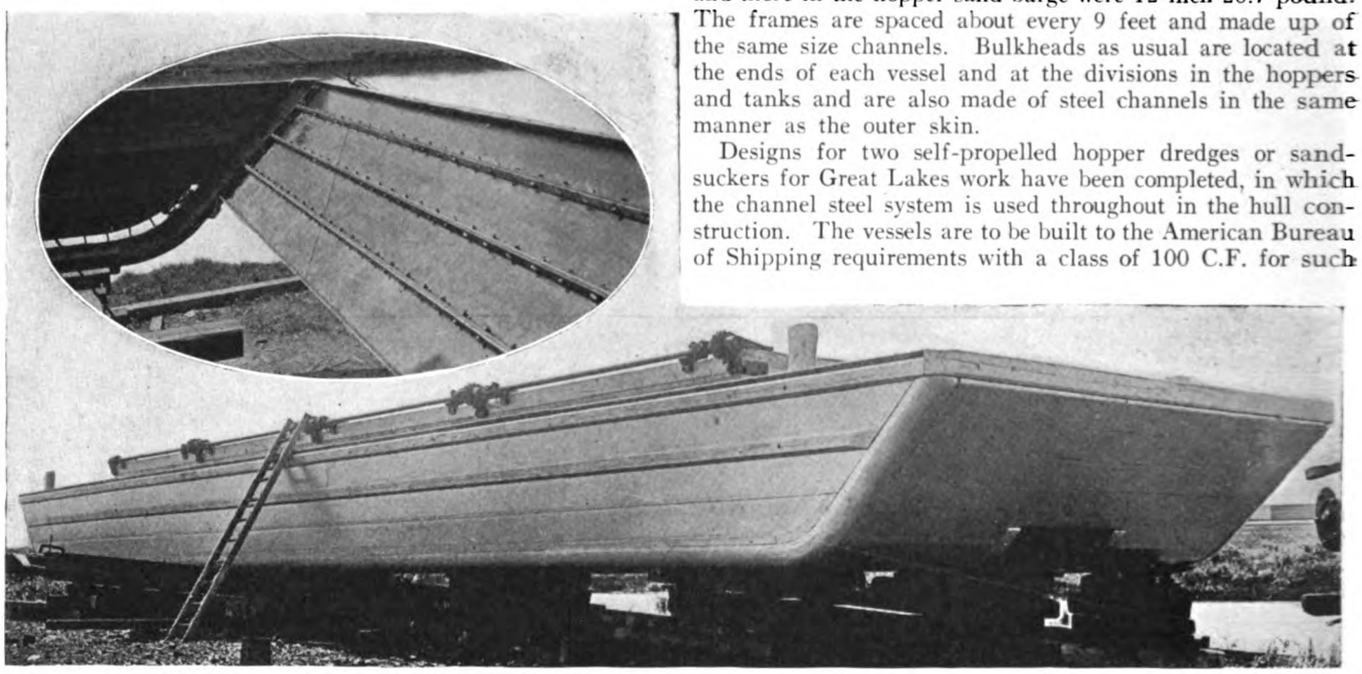
Building Barges of Channel Sections Bolted Together

A NOVEL type of steel vessel construction, known as the channel steel system, particularly adapted to the fabrication of barges, has been developed by the Channel Steel Barge Company, Rome, N. Y.

The principal feature of the channel steel system is that the outer skin of the vessel is made entirely of standard steel channels which run lengthwise of the hull with the flanges turned inward. The flanges are bolted together with standard iron machine bolts, the spacing of which is governed by the size and type of vessel and by the kind of work the vessel is intended to perform. A special felt gasket between the flanges makes the seam permanently air and watertight.



View of Completed Barge. Insert Shows Method of Construction

Should the vessel sustain serious damage, the channel strakes could be removed with but little trouble, and a new gasket put in, or the seam calked. For oil tight work, the felt gasket is surrounded by a thin metal casing before it is set up. Transverse frames are used, but only at intervals, the spacing averaging between 8 and 16 feet. No other framing is required as the flanges of the channels possess great stiffness and form longitudinal girders which run the entire length of the vessel.

First Vessel Built in 1922

The first channel steel vessel was constructed in 1922 and was a hopper bottom sand barge, 116 feet overall length, 22 feet beam, and 10 feet 6 inches molded depth. Her draft completed was 16 inches. The hull, however, was not built entirely of steel, there being a 6-inch piece of yellow pine planking between each steel channel with the fastening bolts running entirely through the planking and the flanges of the channels. A special felt gasket was interposed between the channel flanges and the wood member. To test the strength of the barge before launching, all intermediate blockings were removed and the hull rested on the two end blocks, 95 feet between supports. It stood for 24 hours in this manner without any sign of sagging or buckling. It was then balanced on the midship block and all other blocks removed. It showed no sign of straining or injury after this test.

The second one built under this system was entirely of steel, with the exception of a wood fender strake interposed between two strakes of the steel channels. The hopper combing and gunwale strake were also of wood. This barge is a 125-yard pocket dump scow, with a tunnel running the entire length of the barge underneath the pocket doors and was built for the state of New York. She is 100 feet in length, 22 feet beam and 5 feet 6 inches molded depth. The channels used in this construction were 15-inch 33.9-pound and those in the hopper sand barge were 12-inch 20.7-pound. The frames are spaced about every 9 feet and made up of the same size channels. Bulkheads as usual are located at the ends of each vessel and at the divisions in the hoppers and tanks and are also made of steel channels in the same manner as the outer skin.

Designs for two self-propelled hopper dredges or sand-suckers for Great Lakes work have been completed, in which the channel steel system is used throughout in the hull construction. The vessels are to be built to the American Bureau of Shipping requirements with a class of 100 C.F. for such work. Each vessel is of the regular lake type with machinery aft, 200 feet overall length, 42 feet beam and 16 feet 9 inches molded depth.

Employment of United States Merchant Vessels

THE employment of vessels of 1,000 gross tons and over in the merchant marine of the United States on January 1, 1924, is shown in the report just issued by the Bureau of Research of the United States Shipping Board. During the year 1923, the total privately-owned fleet (excluding tankers) was increased by 13 vessels and 83,178 gross tons, bringing the total under private ownership on January 1, 1924, to 766 vessels of 3,020,651 gross tons. This increase was the net result of additions through construction and transfers from Government departments after the deductions had been made for losses and transfers to foreign flag ownership. The additions to the fleet were, by new construction, 14 vessels of 55,830 gross tons, by transfer from Government departments (principally Shipping Board sales) 45 vessels of 187,019 gross tons and by redocumentation 8 vessels of 19,958 gross tons, a total of 67 vessels of 262,807 gross tons.

The total of the merchant vessels of 1,000 gross tons and over, under the American flag (including tankers but omitting vessels employed exclusively on the Great Lakes), is shown to be 2,385 vessels of 11,368,113 gross tons. Of this total the Government owns 1,288 vessels of 6,317,914 gross tons and private capital 1,097 vessels of 5,050,199 gross tons.

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Anchor-Donaldson Line Places New Intermediate Type Liner in Glasgow and Montreal Passenger Service

New Vessel Carries Cabin and Third Class Passengers— Propulsion Is By Twin Screw Geared Turbine Machinery

THE latest addition to the Glasgow-Montreal service of the Anchor-Donaldson Line, of Glasgow, is the twin screw geared turbine cabin and third class passenger liner *Athenia* built by the Fairfield Shipbuilding & Engineering Company, Govan. The new vessel is 538 feet 2 inches in overall length, 66 feet in breadth and 50 feet 3 inches in depth. She draws 27 feet 8 inches of water when fully loaded and has a gross tonnage of 12,000. Equipped with Brown-Curtis turbines of 8,700 shaft horsepower, driving twin screws through double reduction gearing, she is capable of a regular service speed of 15 knots.

Built to the special survey of The British Corporation and Board of Trade, the vessel is of the "shelter deck" type with a bridge deck extending almost the full length, with promenade and boat decks above, and having two complete 'tween decks.

Details of Hull

The hull is sub-divided into 11 main transverse watertight compartments. The double bottom extends all fore and aft between the peak bulkheads and is utilized for the carriage of oil fuel, reserve feed water, fresh water and water ballast. The fore peak and aft peaks may be used for either fresh or salt water, while No. 6 hold is divided longitudinally into two oiltight compartments into which cargo, cargo oil, or water ballast may be filled. The doors in the watertight bulkheads slide horizontally and are controlled by the "Stone" patent hydraulic system. They may be operated by power from the navigating bridge or by hand either locally or from the shelter deck.

Transverse oil bunkers and settling tanks are situated at the after end of the boiler room. The amount of the oil fuel in these tanks is registered in the boiler room by "Teledep" gages.

With all oil fuel compartments filled the ship can steam at 15 knots for 22 days without replenishing.

Cargo is carried in the lower holds and 'tween decks both forward and aft. Two large compartments for insulated cargo are situated on the main deck aft, while spaces for ship's stores, both insulated and non-insulated, are on the main deck forward. The insulating medium is granulated cork retained in place by two thicknesses of tongued-and-grooved wood lining.

Electric Installation

Electric power and lighting is obtained from two sets of steam driven geared turbines, each coupled to a dynamo giving an output of 250 kilowatts at 110 volts. In case of accident an emergency set is situated on boat deck and consists of a Thornycroft oil engine coupled to an Allen dynamo giving 36 kilowatts at 110 volts.

Refrigeration for cargo, ship's provisions, cold cupboards in kitchens, cooled water and ice-making is obtained by the circulation of cooled brine by a steam-driven CO_2 installation.

Deck Machinery

With the exception of two electric boat winches the deck machinery is all steam driven, and comprises a 12-inch by 14-inch windlass; fourteen 7-inch by 12-inch cargo winches, and a 12½-inch by 10-inch warping capstan.

Two steel derricks are fitted at each of the seven cargo hatches and special attention has been paid to the arrangements of these so that the cargo may be loaded and discharged with as much expedition as on a purely cargo-carrying ship.

The steering gear is on the "Hele-Shaw Martineau" principle and is situated on a small flat below "E" deck. It consists of two electric motors, each coupled to a Hele-Shaw pump which drives two of the four rams connected to the rudder crosshead. Only one pump and motor are required to steer the vessel. The gear is controlled by hydraulic telemotors from both the navigating and docking bridges, with a mechanical extension to the flying bridge, and mechanical control in the steering compartment.

The wheel house and wings on the navigating bridge are well screened from the weather and here are found the recording, controlling and communicating apparatus in connection with all the maneuvering and safety devices on the ship. This arrangement ensures that the officer on watch has complete control of the vessel in case of emergency.

The vessel is equipped with a gyroscopic compass installation of the latest pattern.

The Marconi wireless telegraphy house is on the boat deck.

Patent "nested" lifeboats of the Murray and Clemson type are installed under Welin patent davits. In no case has one pair of davits to serve more than two lifeboats. The seating accommodation in the lifeboats is in excess of the total of passengers and crew combined.

The ship is divided by fireproof bulkheads, and steam, water, fire-foam and hand extinguishers are all available in case of fire.

Passenger Accommodations

Spacious and well appointed accommodations are provided for: 516 cabin passengers, 974 third class passengers and 297 officers and crew.

The dining saloon on the upper deck occupies the full width of the ship and has seating accommodations for 264 passengers. Situated at the foot of the main staircase, the dining saloon is designed in the style of the Italian Renaissance. In the center of the ceiling is a domed portion supported by a column of Scagliola marble. The walls are richly ornamented by tapestry of old Venetian scenes. The room is finished in a warm cream color, and the whole effect is brightened with colored curtains and mirrors between the windows.

The lounge hall is entered by two vestibules from the deck and forms a gallery 40 feet in length along the port side. The decoration is in the style of the later French Renaissance, and is ornamented with green Scagliola marble columns with gilded capitals. Large windows afford an excellent view forward.

An excellent play-room for the children has been fitted, the walls of which are painted to resemble woodland scenery, with sketches illustrating nursery rhymes and stories. An enamelled dado protects the walls and is brought out along one side to form a locker where the toys are stored. Over the mantelpiece is a copy of Sir Joshua Reynolds' famous picture, "The Age of Innocence." At one end is a playground, separated from the rest of the room by a rail, where the youngest children may play in absolute safety.

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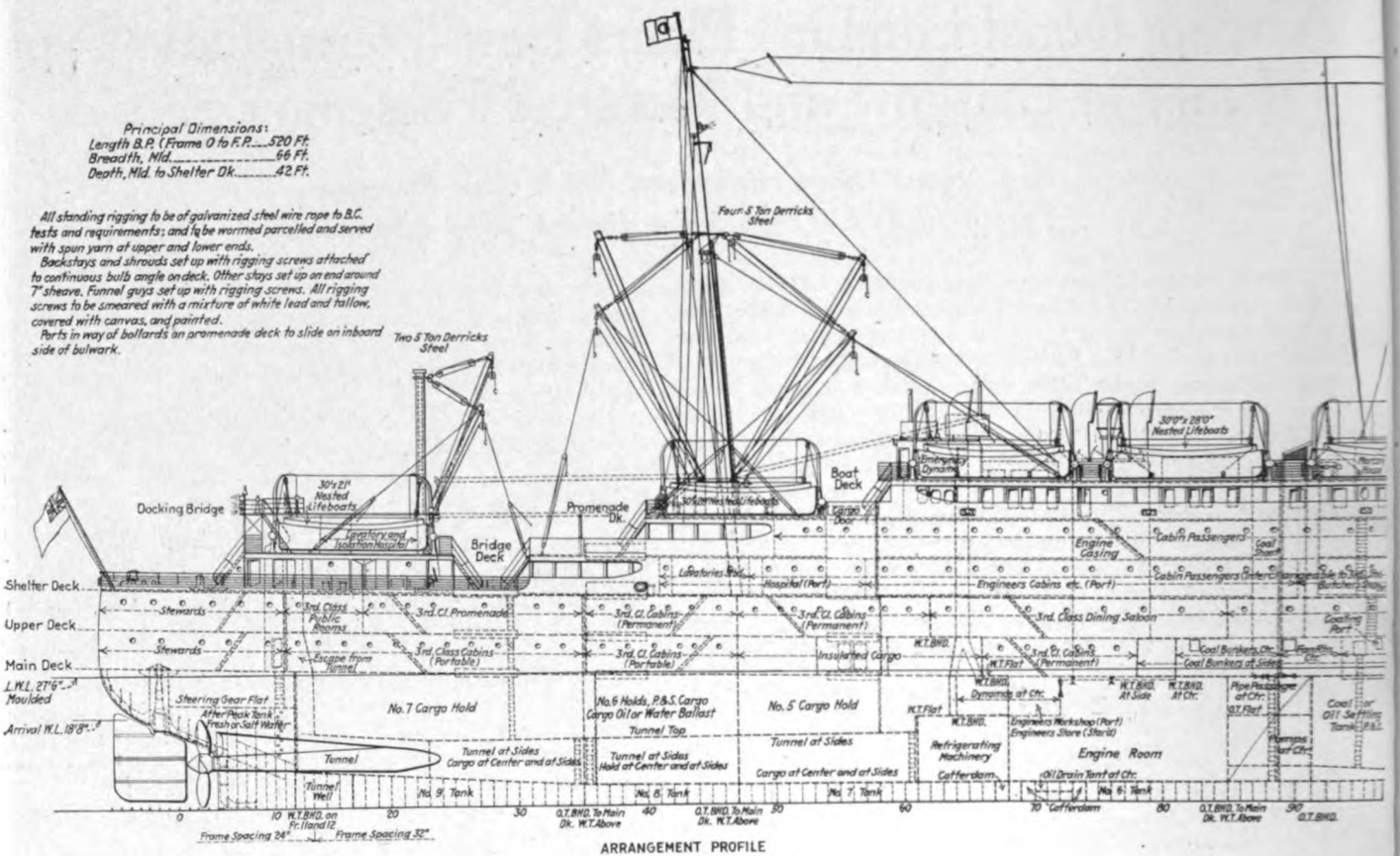
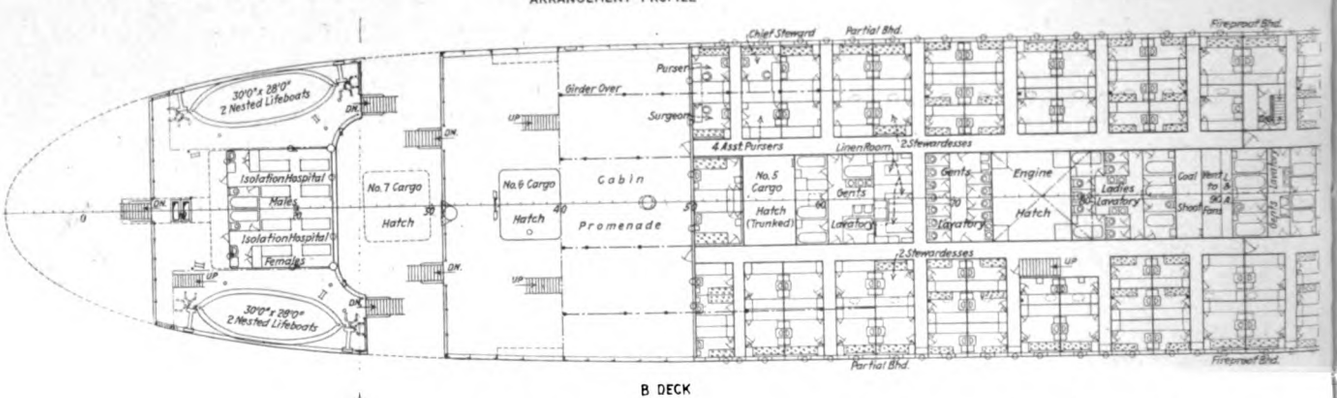
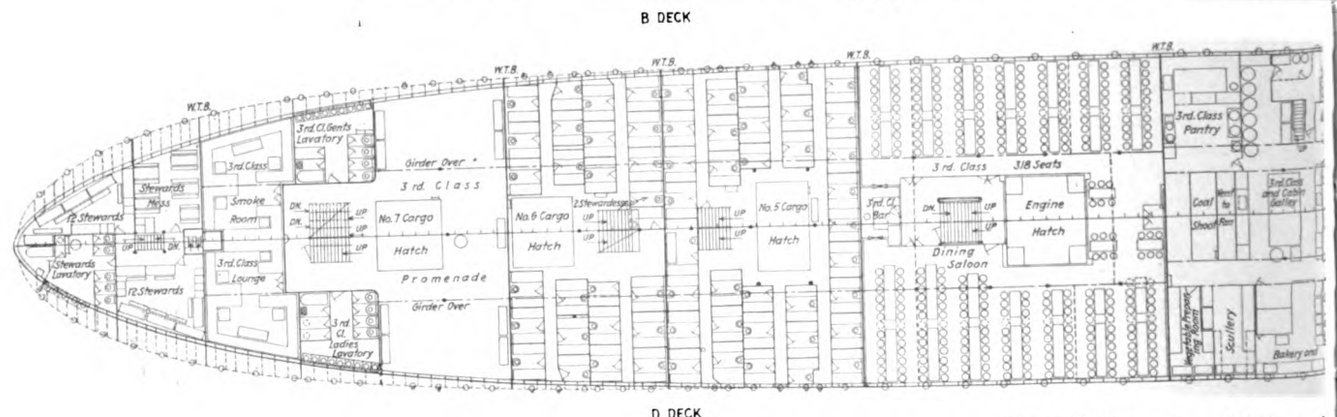

Principal Dimensions:
Length B.P. (Frame 0 to F.P.)....520 Ft.
Breadth, Mld.....66 Ft.
Depth, Mld. to Shelter Dk.....42 Ft.
All standing rigging to be of galvanized steel wire rope to B.C. tests and requirements; and to be wormed parcelled and served with spun yarn at upper and lower ends.
Backstays and shrouds set up with rigging screws attached to continuous bulb angle on deck. Other stays set up on end around 7" sheave. Funnel guys set up with rigging screws. All rigging screws to be smeared with a mixture of white lead and tallow, covered with canvas, and painted.
Ports in way of bollards on promenade deck to slide on inboard side of bulwark.
Four 5 Ton Derricks Steel
Two 5 Ton Derricks Steel
Docking Bridge
Bridge Deck
Promenade Dk.
Boat Deck
Shelter Deck
Upper Deck
Main Deck
Engine Casing
Engineers Cabins etc. (Port)
3rd. Class Dining Saloon
No. 7 Cargo Hold
No. 6 Holds, P.&S. Cargo Cargo Oil or Water Ballast
No. 5 Cargo Hold
Engine Room
Tunnel
Tunnel Top
Insulated Cargo
Refrigerating Machinery
Cofferdam
Frame Spacing 24"
Frame Spacing 32"

ARRANGEMENT PROFILE



B DECK



D DECK

General Arrangement Plans of

The drawing room is designed in the style of the Adam Brothers of the eighteenth century. Elliptical arches and tall pilasters give the appearance of dignity which is always associated with the work of these architects. A handsome antique marble mantelpiece is a prominent feature of the room.

The lounge is decorated in the style of the early Georgian period which is associated with freedom and comfort. The floor area is 40 feet by 20 feet. Over the center of the room is a wrought iron dome supported by richly ornamented pendentives. The walls are finished in a pleasing tone of old ivory which imparts a sense of warmth to the room.

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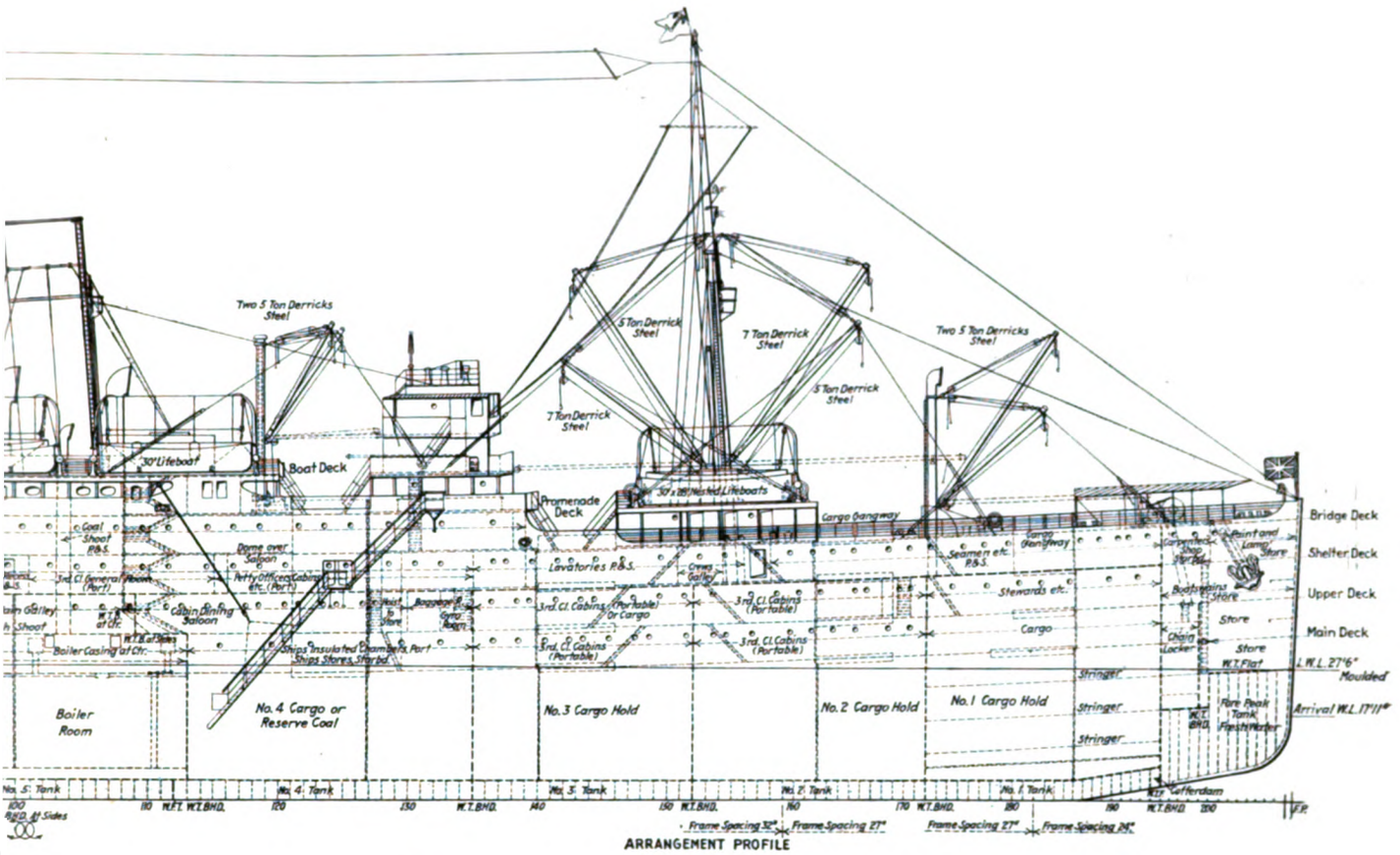
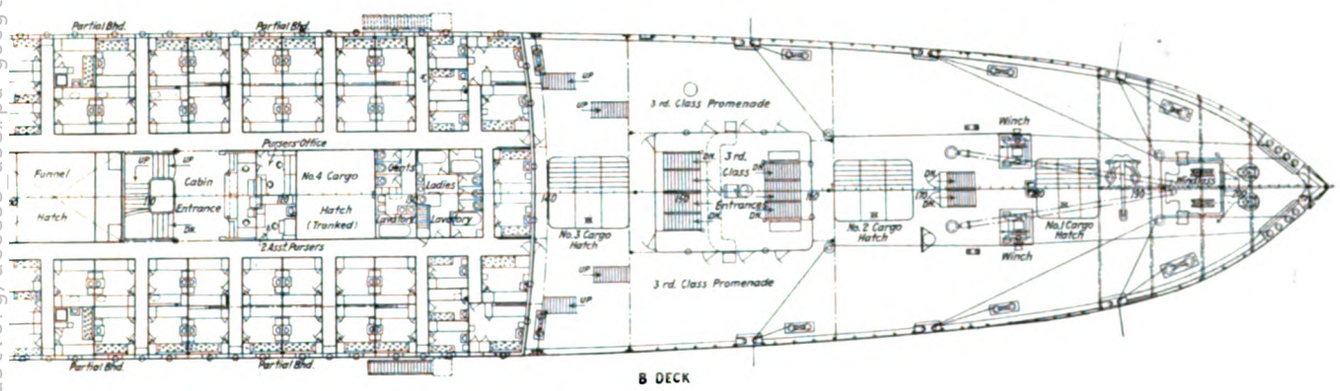


ARRANGEMENT PROFILE



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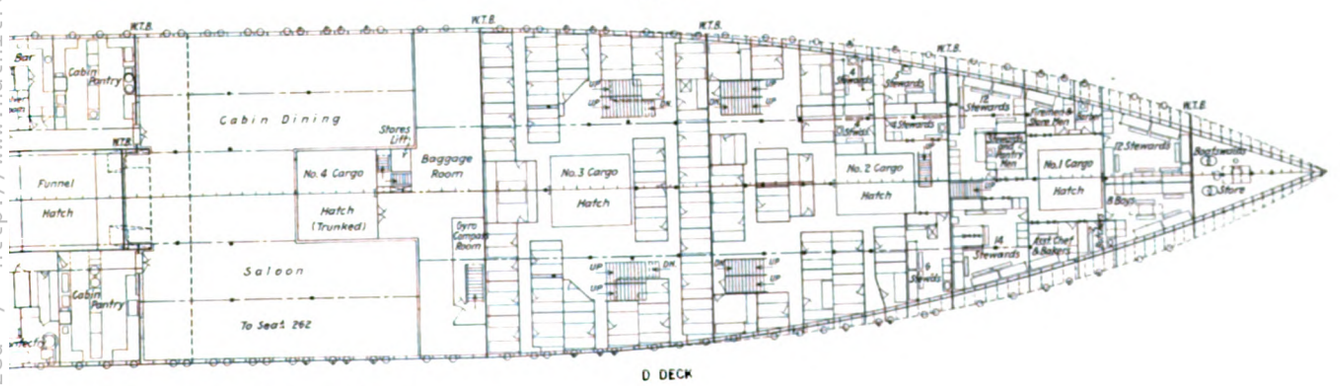

D DECK

Anchor-Donaldson Liner Athenia

The smoking room is finished in dark polished oak, and, like the lounge, it follows the Georgian style. Comfort is the keynote of this room, and the mellow panelling is set off by bright colored hangings.

Opening from the smoking room and leading on to the deck is the verandah cafe, the walls of which are treated to resemble stone and which are covered with teak trellis work.

Staterooms for 254 passengers are situated on "B" deck amidships, and accommodations for 162 cabin passengers are situated on the starboard side of "C" deck amidships. The staterooms are fitted for two or four persons and are finished with wardrobe, settee and small fixed locker seat. In the

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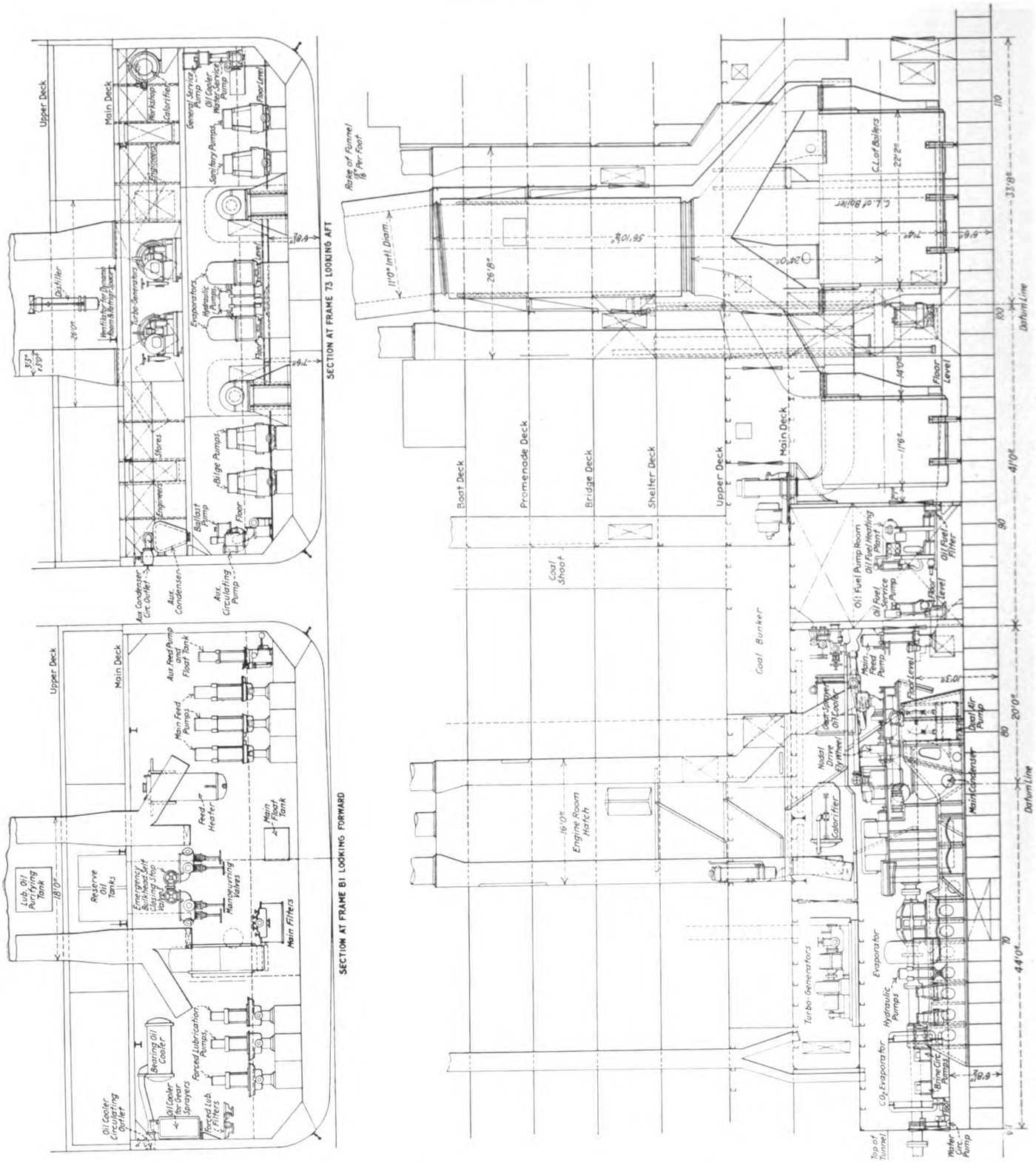

Longitudinal Section Through Engine and Boiler Rooms

two-berth rooms, which are next to the ship's side, the upper bed hinges up against the wall, thus providing a number of special one-berth staterooms. Practically all the inner rooms on "B" deck have a ventilating roof light. All the staterooms on both "B" and "C" decks are fitted with open wash basins with running water, and an even temperature is maintained by a natural supply of cold air with mechanical extraction, in conjunction with a small radiator under the personal control of the occupant. The walls are enamelled white, and the furniture is of polished mahogany; curtains and side-lights are fitted to the berths. A Wilton carpet covers the floor.

Promenade space for the cabin passengers is provided along the whole length of the boat deck and "A" deck, and at the after end of the midship portion of "B" deck.

THIRD CLASS PASSENGER ACCOMMODATIONS

Third class passengers are housed in staterooms for two and four persons on "D" and "E" decks. Those that are permanent are framed and panelled in white enamel with

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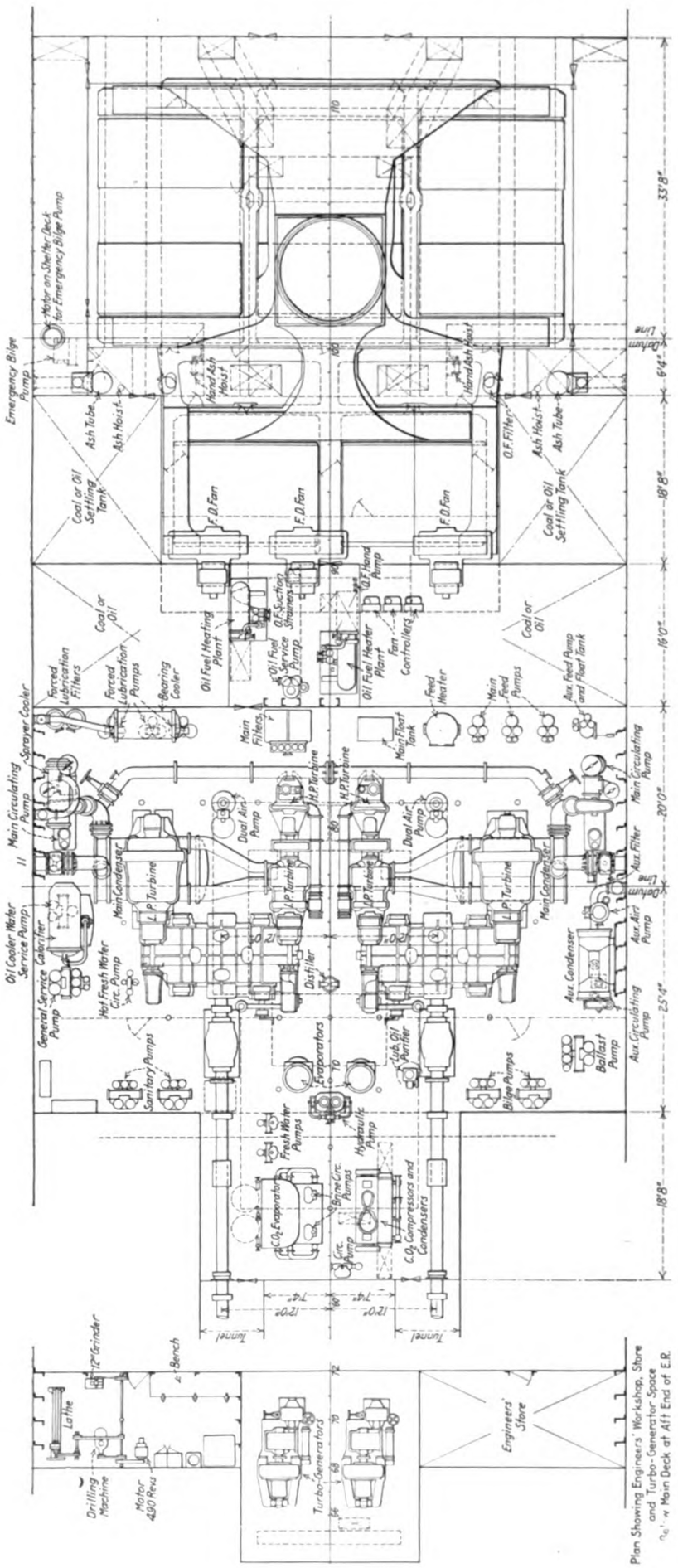

Arrangement of Engine and Boiler Rooms

varnished ash leeboards, seat and folding wash basin. "Portable" third class cabins are similar to the "permanent" rooms, but the walls are not panelled and no folding wash basin is fitted.

An even temperature is maintained in the third class cabins and public rooms by the thermotank system which delivers hot and cold air as necessary, humidified to the correct degree.

Excellent bath, shower, lavatory and wash house accommodations are provided on "C" and "D" decks.

A lounge on "C" deck forward and a lounge and smoking room on "D" deck aft, all panelled in light oak, together with an entrance lounge on "B" deck, provide the third class passengers with four large public rooms, in addition to the dining saloon.

A covered space for promenading adjoins the lounge on "D" deck, while the whole of the forward end of "B" deck and the aft end of "C" deck form extensive promenades.

The kitchens, which have been equipped with the most modern apparatus, are situated on "D" deck amidships, with the cabin dining saloon immediately forward and the third class dining saloon immediately aft.

The third class dining saloon extends the full breadth of the vessel and seats 318 persons. An upright piano is placed in this room which is finished in white enamel with polished mahogany dado.

HOSPITALS

A large consulting room, dispensary and operating theatre, equipped with all the latest medical and surgical appliances, adjoins the male and female hospitals on "C" deck. Isolation hospitals are erected on an island deck at the stern of the ship.

PROPELLING MACHINERY

The propelling machinery was built by The Fairfield Shipbuilding and Engineering Company, Ltd., at Govan, and consists of two sets of Brown-Curtis turbines, driving twin screws through double reduction gearing. Each set comprises three turbines, a high pressure and an intermediate pressure turbine being coupled together in tandem driving one first reduction pinion of the gearing, and a low pressure turbine driving the other first reduction pinion. A high pressure astern turbine is incorporated in the same casing as the intermediate pressure ahead turbine and a low pressure astern turbine is incorporated in the same casing as the low pressure ahead turbine. A condenser is hung below each low pressure turbine exhaust branch, and is fitted with an electrolytic system to prevent erosion of the tubes and plates.

The high pressure turbine rotor is of the solid type and has one two-bucket and five one-bucket wheels. The intermediate pressure rotor is also solid with seven ahead one-bucket wheels, but the high pressure astern three-bucket wheel is separate and

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forced on to the forward end of the spindle. The low pressure rotor is built up of a forged spindle and nine one-bucket ahead wheels together with one three-bucket astern wheel all forced on.

In order to place the various criticals without the working range of revolutions a Workman-Clark system of Nodal drive is fitted, having a flywheel between the high pressure and intermediate pressure rotors to equalize the inertia of the masses on the two sides of the main gear wheel.

An Aspinall governor is fitted to each set of turbines and is so arranged that it operates the emergency steam bulkhead valves either on account of loss in oil pressure in the system or in case of excessive revolutions.

The gearing is of massive construction and is designed to transmit 4,350 shaft horsepower per set at 99 revolutions of the main shaft. The particulars of the gearing are as follows, the teeth being cut by a 7/12-inch standard hob:

	Revolutions	*P.C. Diam. Inches*	*No. of Teeth*
High-intermediate pressure turbine pinion	3,300	8.6	39
Low pressure turbine pinion	2,145	13.3	60
Intermediate wheels	445	64.1	284
Second reduction pinions	445	23.1	104
Main Wheel	99	103.7	467

BOILERS

Steam is generated in three double-ended and two single-ended Scotch boilers installed in one room, and working at 210 pounds pressure with 220 degrees F. superheat.

The boilers are 15 feet 10 inches diameter by 22 feet 2 inches and 11 feet 6 inches long, fitted with three furnaces 3 feet 10 inches diameter per end and have a total heating surface of 22,700 square feet. An electrolytic system similar to that in the condensers is fitted to the boilers to prevent erosion. There is a complete installation in duplicate for burning oil fuel on the Wallsend-Howden system and provision is made for readily converting the boilers to coal burning.

PROPELLERS

The propellers are four-bladed with cast steel bosses and bronze blades, the diameter being 17 feet 6 inches and the pitch 18 feet.

AUXILIARIES

The following auxiliaries are fitted:

Auxiliary.	*No. fitted*	
Auxiliary condenser	1	
Circulating pumps	2	
Auxiliary circulating pump	1	
Oil coolers	2	(1 bearing and 1 sprayer oil)
Lubricating oil pumps	3	
Oil purifier	1	(Centrifugal type)
Forced draft fans	3	(Motor driven)
Feed pumps	3	
Auxiliary feed pump	1	
Air pumps	2	(Dual type)
Auxiliary air pump	1	
Fuel pumps, pressure	2	
Fuel pumps, service	1	
Water service pump	1	(Duplex)
Ballast pump	1	(Duplex)
Bilge pumps	3	(2 steam duplex, and 1 motor)
Sanitary pump	2	(Duplex)
General service pump	1	(Duplex)
Fresh water pumps	2	(Duplex)

Auxiliary.	*No. fitted*	
Evaporators	2	
Distiller	1	
Feed filters, main	2	
Auxiliary feed filter	1	
Feed heater	1	(Surface type)

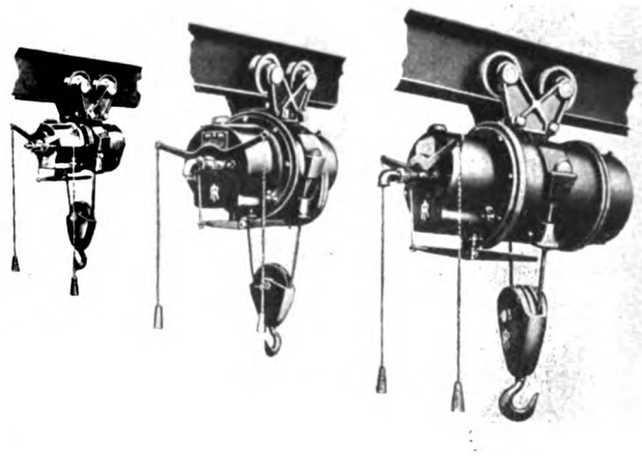
Successful steam trials were carried out in the Firth of Clyde in March, 1923, when a speed of over 17 knots was attained.

New Air Hoist Available in Wide Range of Capacities

THE Ingersoll-Rand Company, New York, is offering a line of new air motor hoists including five different sizes with capacities ranging from 500 pounds to 10,000 pounds, suited for a wide range of service where rapid and economical lifting and handling of loads is desired. These hoists contain many distinctive features and in addition possess all the essential features which two decades of familiarity with the field has shown the manufacturer to be necessary.

The 500 pound capacity hoist (size A) was put on the market a short time ago and now the company has developed four larger sizes of similar design so that the same type of hoist is available for heavier work. The four new sizes embody all the features of the smaller hoist except for such variations, as in the gearing on the two heaviest sizes and similar details.

The outstanding characteristics of the new hoists are briefly as follows: Compactness of design resulting in low



New Ingersoll-Rand Air Hoists

head room required; and relatively light weight; automatic brake which will hold the load under all circumstances—even if the air supply be disconnected or fail; and a graduated throttle which permits a close regulation of both the lifting and the lowering speeds.

A balanced three cylinder air motor is used which operates in either direction and without vibration at any speed or load within the rated capacity of the machine. The motor is of the same type such as has long been provided for Ingersoll-Rand hoists. Some of the advantages claimed for this motor are its freedom from vibration, the ready manner in which it can be throttled down slowly at all loads and the absence of lubricating troubles, even when subjected to considerable neglect.

The throttle graduation on the new hoists is very fine and this ensures instant and complete control of the hoist at any speed and contributes to the excellent operating performance. A safety stop lever is provided which closes the throttle and stops the motor whenever the load is by chance raised to the top of the hoist lift.

The automatic brake consists of a disk attached to the motor shaft, and of a brake plunger with a friction face, which is held in contact with the disk by springs whenever the hoist is not operating, *i.e.*, whenever the air supply to the motor is cut off either by throttling or otherwise.

A roller bearing mono-rail trolley or top hook mounting can be provided as desired.

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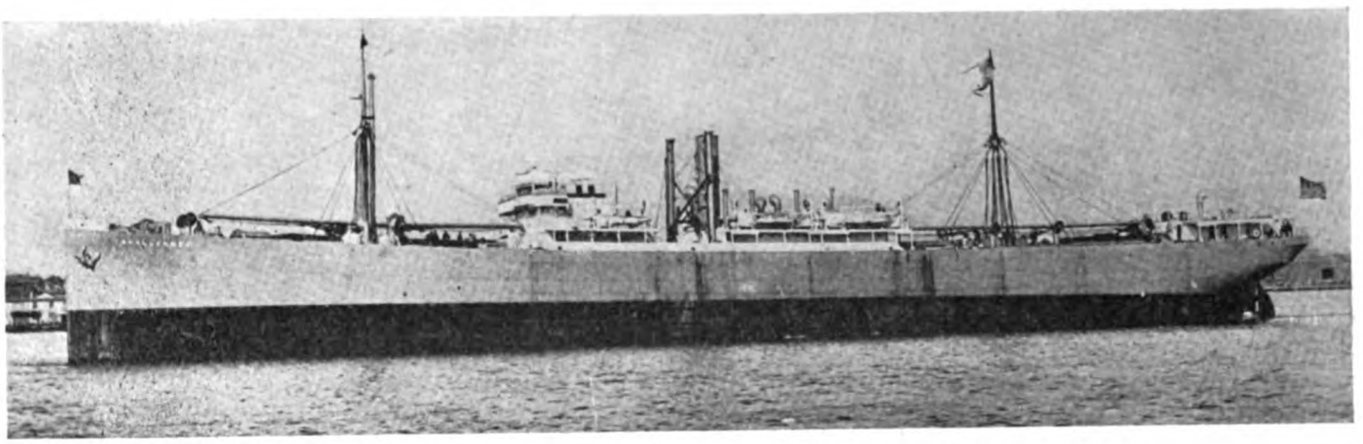

Fig. 1.—Converted American Cargo Motorship Challenger of 11,620 Tons Deadweight

Machinery of the Converted Motorship Challenger

Main Engine Is of the Doxford Opposed Piston Diesel Type—Worthington Auxiliaries and Westinghouse Motors Installed

THE largest American vessel up to the present time to be converted from steam to Diesel drive is the *Challenger,* a former Shipping Board cargo steamer of approximately 11,600 tons deadweight. The successful trial of the new machinery of this vessel was noted in our last issue, and we are now able, through the courtesy of the Sun Shipbuilding Company, the owners of the vessel and builders of the new propelling machinery, as well as of the Worthington Pump & Machinery Corporation and the Westinghouse Electric Company, who furnished the auxiliary machinery, to publish a description and illustrations of the new installation.

The main engine is a two cycle, opposed piston Diesel of the Doxford type, as built by the Sun Shipbuilding Company. While the general characteristics of this design are well known, the dimensions of the engine fitted on the *Challenger* are of interest, as well as a mention of some of the advantages which are claimed as peculiar to this type of Diesel machinery.

Main Particulars of Engine

The general design of the engine is well shown by Fig. 4. Its main particulars are as follows:

Number of cylinders	4
Diameter of cylinders	22¾ inches
Stroke (each piston)	45½ inches
Length of bedplate	38 feet
Length, including thrust block, flywheel and fuel pump	50 feet 10 inches
Height	29 feet
Height, bottom of bed plate to center line of shaft	4 feet 9 inches
Scavenger pump:	
Diameter	62 inches
Stroke	41 inches
Center crank pins:	
Diameter	18.11 inches
Length	20.86 inches

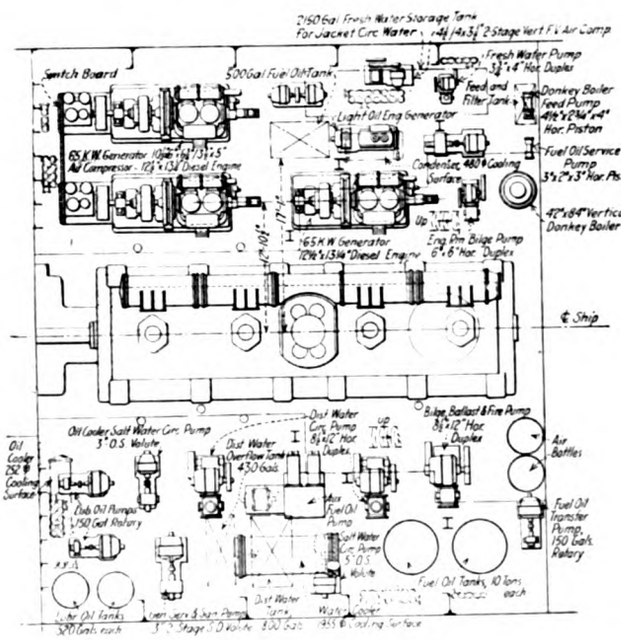

Fig. 2.—Engine Room Plan

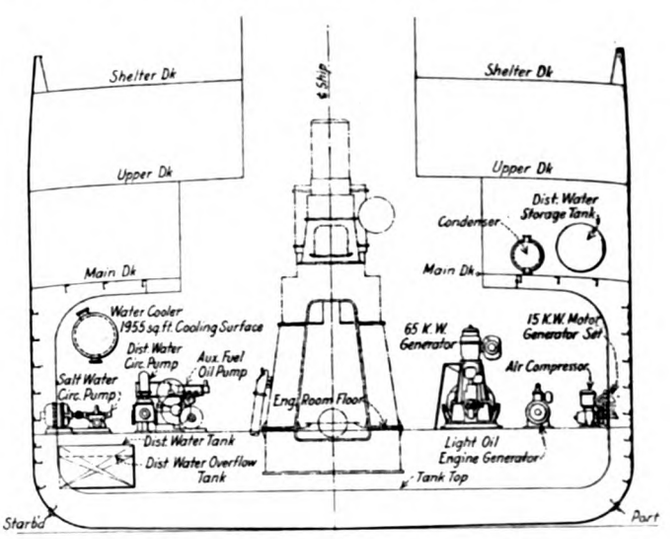

Fig. 3.—Section Through Engine Room at Frame No. 28, Looking Aft

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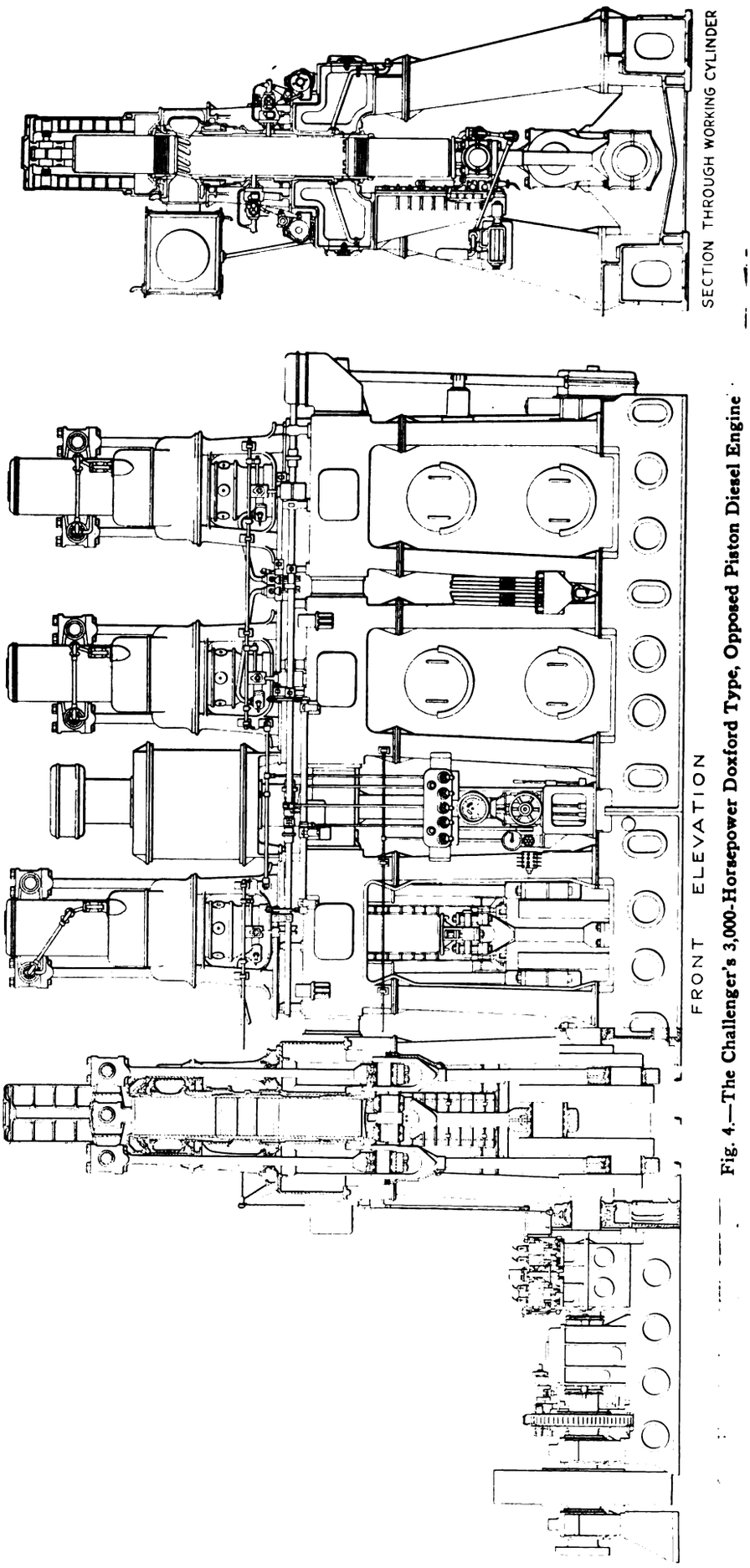

Fig. 4.—The Challenger's 3,000-Horsepower Doxford Type, Opposed Piston Diesel Engine

Side crank pins:
Diameter .....18.11 inches
Length .....10.89 inches
Main bearings (6):
Diameter .....16.92 inches
Length .....14.96 inches
Indicated horsepower at 77 revolutions 3,000
Shaft horsepower at 77 revolutions 2,550
Weight, including fly wheel, thrust and shaft and main fuel pump ..... 370 tons
Mean effective pressure, brake basis.....90 pounds per square inch
Working pressure:
Fuel oil (maximum)..12,000 pounds per square inch
Lubricating oil .....18 pounds per square inch
Circulating water ....18 pounds per square inch
Scavenging air ....0 to 2 pounds per square inch
Maneuvering air .....700 pounds per square inch
Bearing pressure:
Main bearings .....nil
Bottom end..600 pounds per square inch
Top end ..1,000 pounds per square inch
Consumption, fuel oil:
Brake horsepower hour.....0.40 pound
Indicated horsepower hour..0.34 pound
Consumption, lubricating oil per 24 hours .....16 gallons
Cylinder oil per 24 hours ... 7 gallons

An examination of the plans and data disclose several interesting features:

Special Features of the Engine

First: While the stroke of the individual piston is 45½ inches, the effective power stroke of each cylinder is 90 inches, thus making the engine, in effect, double acting, and reducing the number of cylinders and, consequently, the length and weight of engine necessary to develop a given power.

Second: The admission of scavenging air around the entire circumference of each cylinder end and its exit at the center, make possible very complete scavenging with a minimum of air pressure.

Third: While the system of solid fuel injection makes necessary a very high injection pressure, this pressure is confined to valves, piping and fittings of very small dimensions and does away with the operation of a high pressure air compressor in ordinary service at sea.

Fourth: The relatively low cylinder pressure and the opposition of the two pistons reduces the resultant pressure on the main bearings and the bending moment in the crank shaft between these bearings to zero and produces small crank and wrist pin pressures.

The maneuvering of the engine is rapid and its control simple, being accomplished entirely by the hand wheels and levers shown in Fig. 5.

An important quality of this en-

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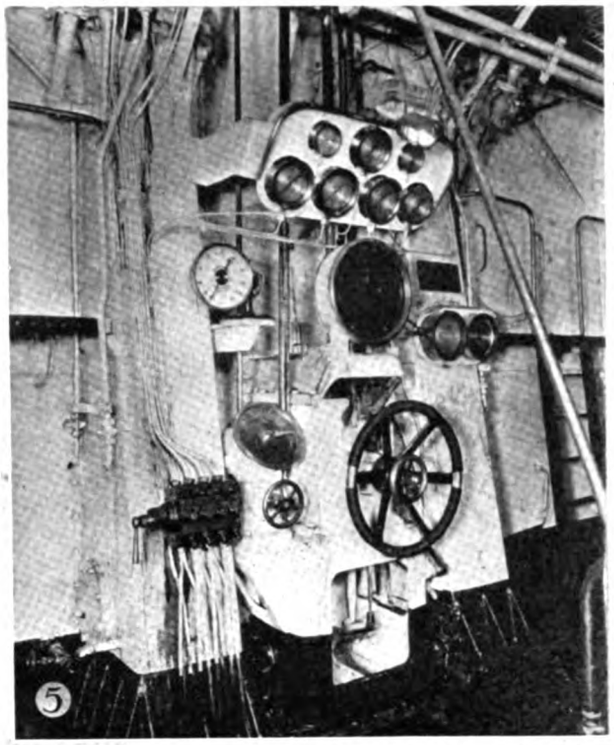

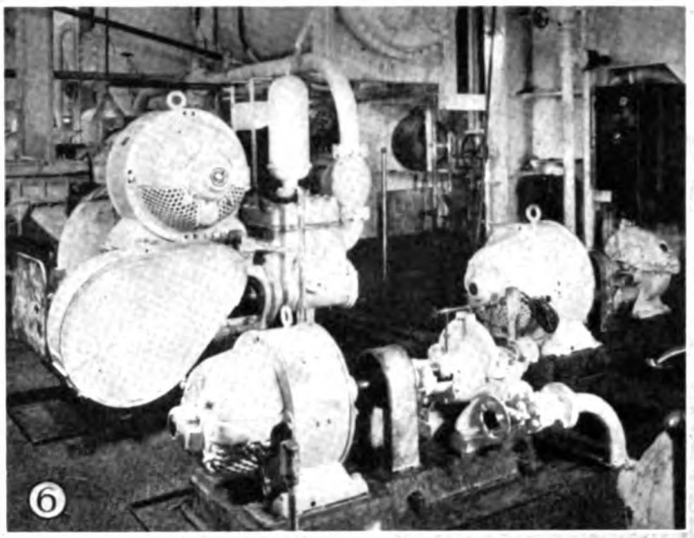

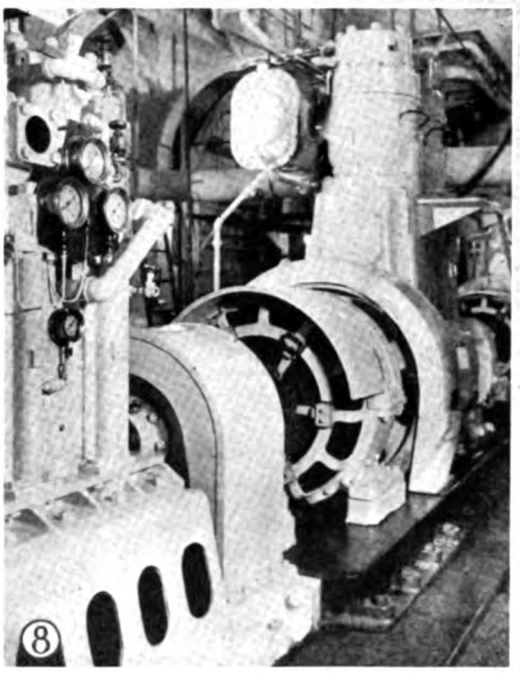

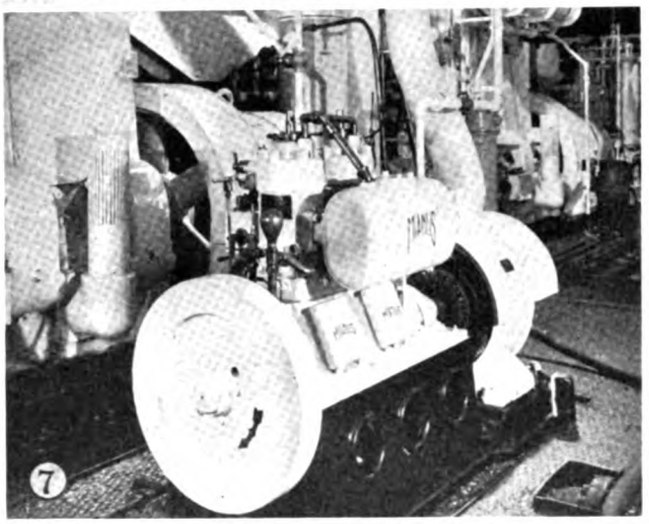

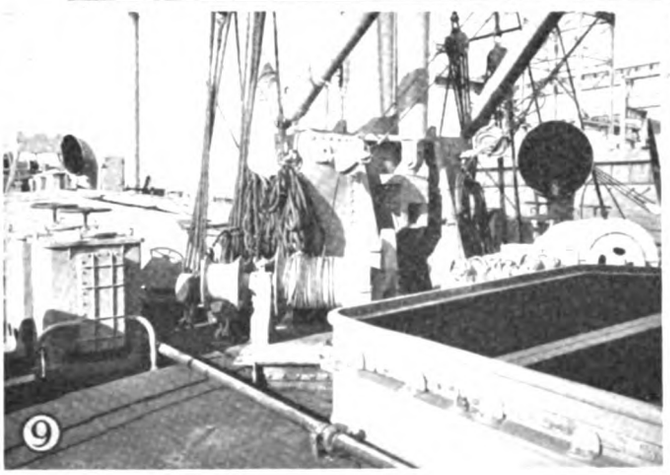

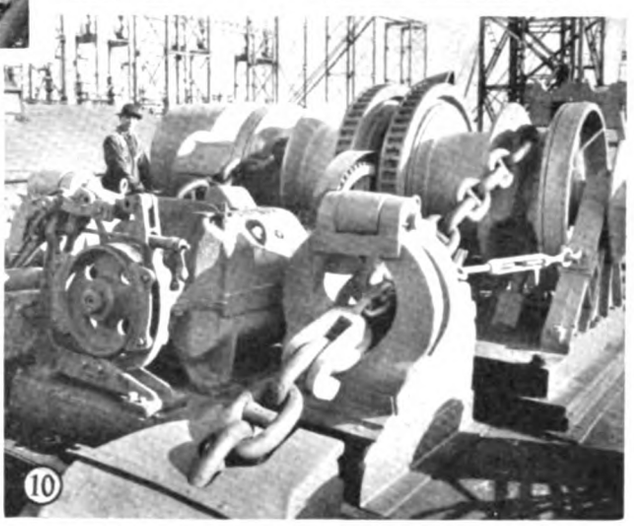

Fig. 5.—Operating Station of Main Engine. Fig. 6.—(Left to Right) Jacket Cooling Pump, Lubricating Oil Pump and General Service Pump. Fig. 7.—Stand-by Generating Set. Fig. 8.—65-Kilowatt Generating Set. Fig. 9.—Deck Winches. Fig. 10.—Windlass

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gine is the low speed (from 17 to 20 revolutions per minute) at which it may be operated.

AUXILIARIES

In order to reap the full advantage obtainable from the use of Diesel machinery, the *Challenger* has been completely fitted with electrically operated auxiliaries, both in the engine room and on deck, the only use of steam being for heating, for which purpose, a small vertical oil-fired boiler is fitted.

The power for driving the auxiliaries is developed by three Worthington-Diesel two-cycle solid injection single acting engines of 100 horsepower each, one of which is shown in Fig. 8. These engines have two cylinders each 12½ inches in diameter and 13¼ inches stroke and develop their rated

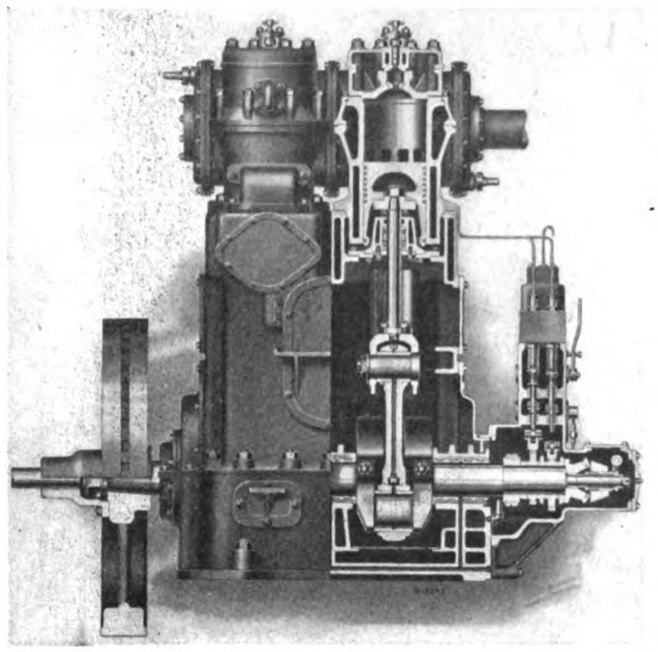

Fig. 11.—Details of Worthington-Diesel Two-Cycle Solid Injection Single Acting Engines Used for Driving the Generators

power at 325 revolutions. Their general design is clearly indicated by Fig. 11. The three generators are of the Westinghouse direct current type each developing 65 kilowatts at 240 volts.

As has already been mentioned, all auxiliaries are electrically driven. The arrangement of the engine room is shown by Figs. 2 and 3. Fig. 7 shows the stand-by generating set, consisting of a Mianus heavy oil engine driving a Westinghouse generator.

DECK AUXILIARIES

The arrangement of the deck winches is shown in Fig. 9. The winch motors are of 20 horsepower at 230 volts and 400 revolutions per minute. It will be noted that the control levers are so located as to give the operator a clear view down the hatch. The winch motor resistances are in the watertight boxes at the left of the illustration.

The capstan is driven by a 20 horsepower watertight motor and control and Fig. 10 shows the 45 horsepower motor and electrically controlled brake which operates the windlass.

Altogether, the *Challenger*, as now converted, is an example of the highest type of motorship, and her first voyage, which, we understand, will be to the Far East, will be watched with great interest by shipbuilders, owners and operators.

The Seekonk's First Voyage

IN connection with Mr. Olson's notes on Diesel engine operation, published on page 169 of this issue, the following extracts from a report on the first voyage of his ship, the M.S. *Seekonk*, are of particular interest.

Total distance run, at sea	12,545 miles
Mean sea speed	10.29 knots
Mean I. H. P., main engine	2,252
Mean I. H. P., auxiliary engine	100
Mean consumption per day at sea, main and auxiliary engines	7.52 tons
Mean consumption per day in port, all purposes	0.70 ton
Mean consumption per I. H. P., main and auxiliary engines	0.298 pound
Miles per ton of fuel	32.8

During the return trip from the west coast, under favorable sea conditions, a three-day test was conducted, with the following results:

Speed, by observation	10.66 knots
Revolutions per minute	86.1
Slip	5.3 percent
Fuel per 24 hours, main and auxiliary engines	7.43 tons
I. H. P., main engines	2,285
I. H. P., auxiliary engines	120
Oil per I. H. P. of main engines, all purposes	0.3035 pound
Oil per I. H. P. of main and auxiliary engines, all purposes	0.2885 pound

When handling cargo, with 10 winches in operation for 8 hours a day, the total consumption of fuel oil for auxiliary engines was 0.42 ton for 24 hours. With oil at $1 per barrel, as paid for under contract on the Pacific coast, the actual fuel cost per ton of cargo handled was 0.3 cent.

Compared with the sister Hog Island ships, having steam drive, the *Seekonk* averages approximately the same speed on about one-fourth the amount of fuel oil, while in port only about one-tenth the amount required by the steamer is used.

Credits for Improvements

IT is not alone the quality of the tonnage and the appliances for safety employed that enter into the making of marine insurance rates. The moral hazard and the attitude of shipowners and operators cut a very important figure. For example, there are two lines running out of New York that serve practically the same ports. One of these lines has a fleet of old ships; the other has modern ones. The former gets, surprising as it may seem, a much better rate than the latter. Why? Because the owners of the older vessels are experienced, careful and honest. In event of loss they never ask for anything but justice and fairness. The owners of the better ships seek to make money on every loss, operate with less efficiency and are regarded generally, among underwriters, as a losing proposition.

In fire insurance the granting of credits for improvements has become so well established that the manufacturers of safety appliances cannot understand why marine underwriters appear reluctant to follow this lead. A little reflection ought to convince them of the traditional fact that marine insurance, unlike fire insurance, is bought in an open world market, and that an installation that is proven by adequate experience to reduce hazards is always eventually recognized in the rate.

It has been so with wireless telegraphy, for example; once the efficacy of that great agency was established the marine rate throughout the world promptly responded with appropriate declines. A reduction in the general loss experience demonstrated the fairness of such recognition. Therefore all that a marine underwriter can say to the safety appliance men is that if, after a sufficient trial, the use of any particular device shows conclusively that it is capable of reducing the marine hazard, that condition will be reflected in the rates in the natural course of business.

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Diesel Electric Towboat Designed for River Service

LATE in December the Diesel electric towboat *J. B. Battle* was completed and delivered to the United States Engineers Office, Mobile, Ala., by the builders, The Charles Ward Engineering Works, Charleston, W. Va. This towboat, designed in the office of the Chief Engineer, at Washington, D. C., includes features that are of interest to operators as well as builders not the least of which is the system of Diesel-electric drive.

The vessel is of the stern-wheel type, with model bow, round bilges and a curved rake, which finishes with a radius at the transom, without the customary sharp intersection between rake and transom. The length on deck is 100 feet; the length overall, 119 feet 4 inches; breadth, molded, 23 feet; depth, 5 feet; and the loaded draft, with full supply of fuel oil, water, and all equipment, is 3 feet 6 inches.

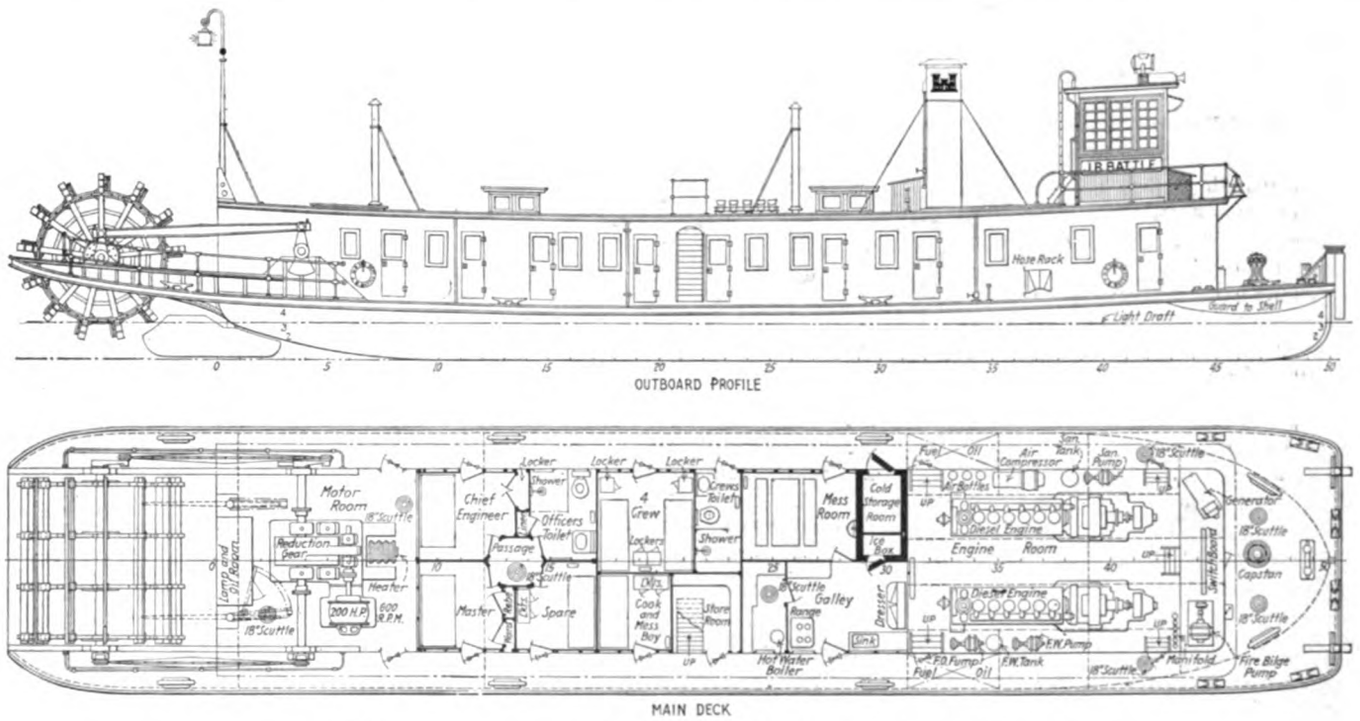
Diesel Electric Towboat J. B. Battle

There are three watertight transverse bulkheads subdividing the hull into four watertight compartments. A complete steel deck is fitted over the entire hull, with a sunken deck in way of the engine room, which brings the center of gravity of the heavy machinery parts low enough to insure a greater stability than is usually found in river vessels.

The entire deck house is built of light steel, with steel doors, fitted with ¼ inch wired glass, making the entire outside of the house as nearly fireproof as possible. About 28 feet of the deck house at the forward end is taken up by the engine room, leaving approximately 10 feet of deck space between the bow of the vessel and the forward deck house. Aft of the engine room are the quarters for the officers and the crew, occupying approximately 44 feet. Aft of this space, the balance of the deck house, about 18 feet, is taken up by the gear room, lamp and oil room, and the hot water heater. The floors in the living quarters consist of ½ inch Asbestolith, and in the galley, porcelain tiling, laid in cement. The windows are of usual vertical sliding type, fitted with blinds and copper screens. Steel lockers and white enameled beds are installed in the quarters.

DETAILS OF MACHINERY

Two full Diesel engines, manufactured by the Winton Engine Works, Cleveland, Ohio, are installed in the engine room in the forward part of the deck house. These engines are of the four cycle six cylinder type and develop about 149 brake horsepower each. They are direct connected to generators having an output of 90 kilowatts each, with an exciter of 10 kilowatts on the same shaft. The current generated is transmitted through a specially constructed cable to the switchboard, where the distribution is made and a special control, operated from the pilot house above, enables the master of the vessel to operate the motor independent of the engine room force. The power cables are led through the hull into the gear room at the after end of the deck house and connected to a 200 horsepower motor which, through a flexible coupling in the pinion shaft, transmits



General Arrangement Plans of Diesel Electric River Towboat J. B. Battle

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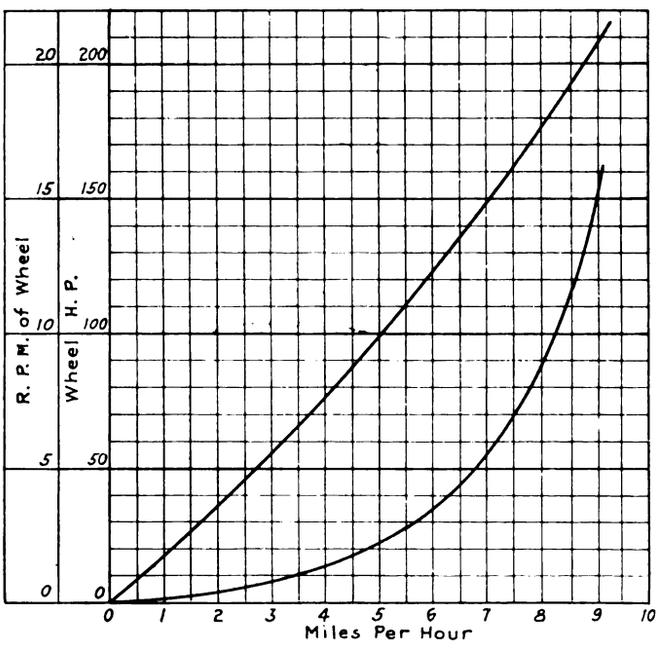
	One-quarter Revolutions	One-half Revolutions			Three-quarter Revolutions			Full Revolutions		
	Run No. 1 Up	Run No. 2 Down	Run No. 3 Up	Run No. 3 Corrected	Run No. 4 Down	Run No. 5 Up	Run No. 5 Corrected	Run No. 6 Down	Run No. 7 Up	Run No. 7 Corrected
Time	41.5	9.72	15.94	14.14	7.32	9.59	9.43	6.01	7.32	7.366
Total wheel revolution	197	100	146.07	....	114	147	....	126	155	....
Wheel revolutions per minute	4.75	10.32	9.16	10.32	15.63	15.37	15.63	21.07	21.2	21.7
Speed	1.445	6.173	3.764	4.243	8.196	6.256	6.360	9.983	8.197	8.185
Current	(.96)	.965	....	....	.963	....	....	.969	....	....
Speed of boat	2.4	5.2	4.74	....	7.23	7.22	....	9.01	9.16	....
Kilowatt hours to main	2.85	3.5	4.75	....	6.75	8.25	....	13.5	17.5	....
Horsepower to main motor	5.53	29.0	23.9	....	74.3	69.2	....	181	192	....
Motor horsepower, Eff. about 93 percent	5.13	26.9	22.3	....	69	64.5	....	168	176	....
Excitation load horsepower, exciter No. 1	2.8	3.9	3.9	....	4.39	4.25	....	5.75	5.75	....
Total horsepower for main drive	8.33	32.9	27.8	....	78.69	73.45	....	186.75	197.75	....
Average horsepower for auxiliaries	2.0	2.0	2.0	....	2.0	2.0	....	2.0	2.0	....
Total horsepower generators	10.33	34.9	29.8	....	80.69	75.45	....	188.75	199.75	....
Wheel shaft horsepower est. 10 percent loss from motor	4.61	24.21	20.07	....	62.1	58.05	....	151.2	158.4	....

the power through a Fawcus double reduction gear to a lay shaft, with a 23 to 1 speed reduction. The stern-wheel is 15 feet in diameter, with 13 buckets 30 inches wide and 15 feet long.

There is installed at the port side of the engine room an auxiliary two-stage air compressor, of sufficient capacity to



Speed-Power Curves Developed on Trial Trip

furnish the compressed air necessary for the starting of the engines. Forward of the compressor, the sanitary pump is located, which is of the rotary type, manufactured by the Northern Fire Apparatus Co. This pump has a capacity of 20 gallons per minute, with a working pressure of 20 pounds per square inch. On the starboard side, a fuel oil pump and a fresh water pump are located, both motor driven. At the forward end of the engine rooms, a switchboard is placed in the center of the vessel, with the auxiliary generator on the port side and the fire and bilge pump on the starboard side. The fire and bilge pump is a Rotary pump, of the Northern Fire Apparatus Company's make, with a capacity of 165 gallons per minute, and a working pressure of 60 pounds per square inch. The auxiliary generator is a 7½ kilowatts 125 volt direct current generator, driven by a gasoline engine manufactured by the Winton Engine Works. This generator is used for driving any or all of the auxiliaries and also for supplying light aboard the vessel when the main engines are not running.

An electrically driven capstan, of Hyde Windlass make, is installed on the forward deck. A drum type controller is mounted at the forward end of the deck house, and the capstan is capable of exerting a line pull of 6,000 pounds at 15 feet per minute.

The entire electrical equipment is of Westinghouse make.

The fuel oil tanks located in the wing compartments at the after end of the engine room, have a capacity of about 1,600 gallons, and the fuel oil system devised by the Maritime Hydraulic Oil Service is installed.

Control of Vessel

The *J. B. Battle* comes nearer to a one-man controlled towboat, of its size, than any vessel now operated on the western rivers. After the engines have been started and brought up to speed, the entire control of the vessel is taken care of from the pilot house by one man, who with the aid of a duplicate set of instruments mounted on a control stand is able to know at all times the amount of current the motor is using and the number of revolutions the stern-wheel is making. The controller mounted under the pilot house floor, provides for 30 running speeds ahead or reverse.

The vessel left Charleston, W. Va., December 7 and reached Mobile, Ala., on December 28. The delivery trip was highly successful.

Barge Towing Regulations

THE Board of Underwriters of New York has written Secretary of Commerce Hoover requesting that as the necessity which caused the suspension of the barge towing regulations no longer exists, and as the continuance of the suspension constitutes a serious menace, said suspension be terminated and the regulations again be in force. The Secretary of Commerce suspended the regulations in June, 1917, for the duration of the war or until further notice. At that time there was a very acute shortage of coal-carrying tonnage on the Atlantic coast. Today, however, the coastal tows are, in instances, more than a mile in length, involving a great risk of collision with vessels that must keep within the channel, not to mention the serious hazard of the tows going ashore. Frequent complaints are being made by masters of coastwise steamers to their owners, advising that they often are put in dangerous situations in consequence.

Hamburg-American Line Has New Ship

THE new liner *Deutschland* of the Hamburg-American Line will sail from Hamburg on her maiden voyage March 27. She will sail regularly between New York and Hamburg, via Southampton, in the joint service maintained by the United American Lines and the Hamburg-American Line.

The *Deutschland* is a steamer of 22,000 gross tons register and is over 600 feet in length. She is a twin screw oil burner, built by Blohm & Voss at Hamburg. Her propelling machinery consists of 8 turbines driving two lines of shafting through single reduction gears. The passenger accommodations are for 250 in first class, 350 in second class and 1,000 in third class.

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A New Oil Engine of American Design

Description of New Bethlehem Two-Cycle Diesel Type Engine as Installed on the Motorship Cubore—Important Features of Design

THE new Bethlehem oil engine is the logical outgrowth of fourteen years' experience with gas engine power plant practice on an unusually large scale, using units of 5,500 horsepower each, for the most part, under the hardest possible conditions of continuous steel mill service.

This oil engine has been given a thorough try-out in both land and marine service. About three years ago one of these engines was installed in the *Cubore,* a 10,500-ton motorship belonging to the Ore Steamship Corporation, a subsidiary of the Bethlehem Steel Company. As a result of this experience minor changes were recently made in the engine and on February 8 a number of experts prominent in the marine world were given an opportunity to see what it would do.

Another engine of the same type is installed in and has been in successful operation at the power house of the Lehigh plant of the Bethlehem Steel Company for over a year.

Details of the Engine

The important features of the Bethlehem oil engine are fully shown in the accompanying illustrations. It is of the vertical, two-stroke cycle, single-acting type, constructed in units of four, six or eight cylinders, running at a speed of from 116 revolutions per minute for land power and twin screw marine purposes down to 90 revolutions per minute for single screw marine use.

The even torque of the two-stroke cycle type makes the engine steady in operation, as is demonstrated by a six-cylinder engine without a flywheel in regular operation in the Bethlehem power station, producing alternating current in parallel with 40,000 horsepower of gas engines. The effect of this regularity of turning moment in marine service is illustrated by the case of the motorship *Cubore,* which is equipped with a six-cylinder two cycle oil engine of this de-

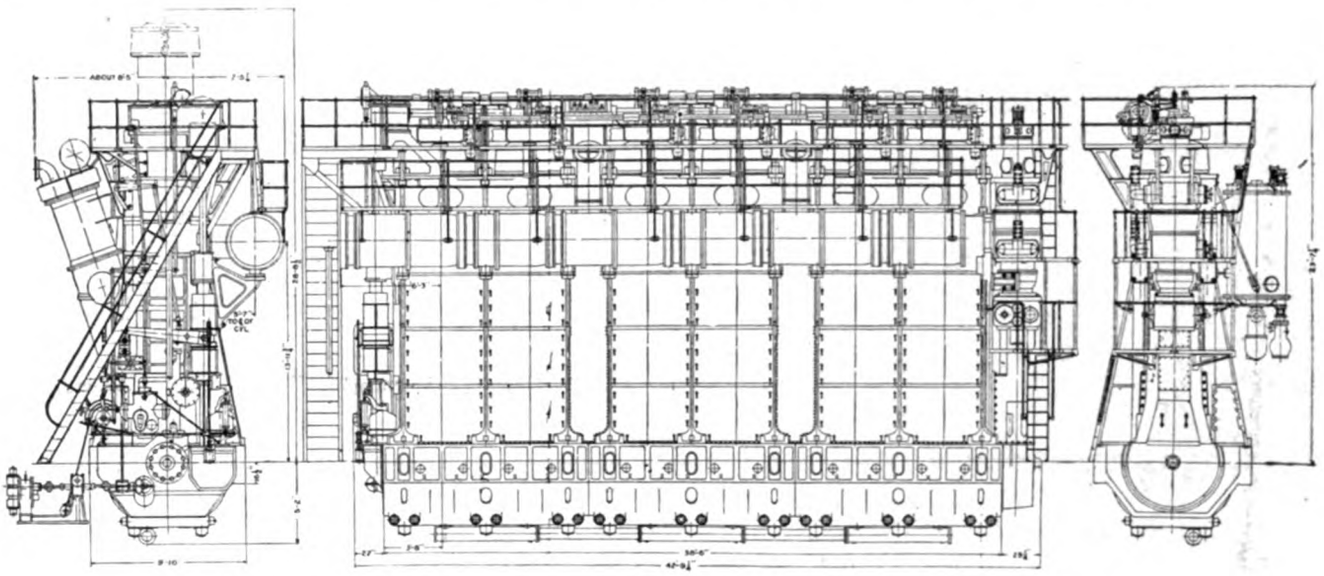

Fig. 1.—New Six-Cylinder, Two-Cycle, Single Acting Bethlehem Diesel Engine

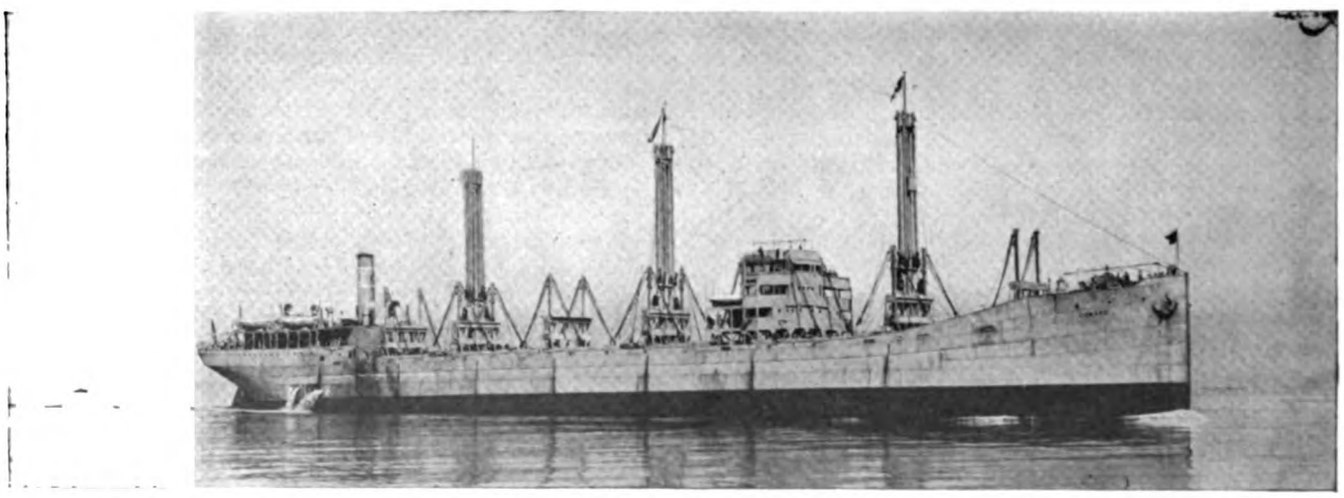

Fig. 2.—Motorship Cubore, Which Is Equipped With a 2,500 Shaft Horsepower Bethlehem Diesel Engine

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sign developing 2,500 shaft horsepower, at 98 revolutions per minute. This engine functions satisfactorily at all speeds down to 20 revolutions per minute and under all marine conditions without the aid of a flywheel. This regularity of turning torque has particular advantages in a marine installation, in that it permits a reduction in the size of the line, thrust and propeller shafts.

In the conversion of ships from steam to oil engine drive, a matter of utmost importance to the merchant marine, the Bethlehem engine can be installed in most cases without having to increase, and therefore renew, the line, thrust, and propeller shafts already in the ship.

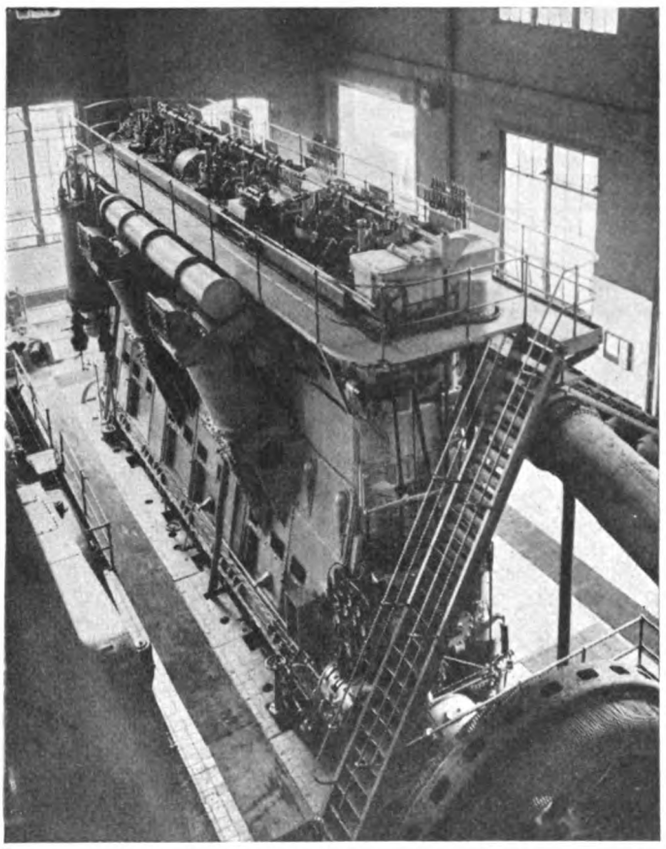

Fig. 3.—Bethlehem Engine In Operation at Lehigh Plant of Bethlehem Steel Company

Cylinder Design

The basic idea was to create an engine in which all parts subject to flame temperatures would be able to resist successfully for an indefinite time the combination of temperature and pressure stresses inseparable from the operation of oil engines under heavy load. To accomplish this, the power cylinder was designed as indicated in Fig. 4 and in the section through the engine, Fig. 5. It will be seen that the inner and outer cylinder walls are united only at the top and at a point entirely removed from the heat of combustion. By means of the flanges shown, the cylinders are mounted in pairs in a casting designed to receive them. The power cylinder projects downwardly through this casting, to which it is attached only at the upper flange. Consequently the cylinder is free to expand in all directions without setting up stresses in any working part.

The expansion differences in length increase as the stroke and consequently the length of power cylinder increases. The construction of the Bethlehem engine is carefully planned to avoid trouble from this source. As Fig. 4 well shows, the cylinder is cast with the water jacket space very open and accessible. This opening in the outer jacket wall is closed by a light cast iron sleeve attached to the power cylinder at its upper end by a flange and provided at its lower end with a water joint permitting axial expansion without danger of leakage. This sleeve does not appear in Fig. 4, but is well shown on the section Fig. 5. This cylinder construction permits the cores to be accurately supported and provides for the adequate inspection and cleaning of the entire water jacketed surface. It will be noted that the exhaust ports are cast integrally with the cylinder barrel, thus avoiding any joint between the cylinder barrel and exhaust ports. In using fuels high in sulphur, this element will also of course be present in the engine exhaust and the slightest water leak through such a joint would produce troublesome corrosion.

Fig. 4.—Power Cylinder

By reference to Fig. 5, it will be seen that the cylinder is held down to its cylinder support by studs passing through the two upper cylinder flanges. With the construction shown it is evident that no axial tension stresses pass through the cylinder barrel or exhaust ports so that all danger of the cylinder castings becoming cracked from the working stresses set up by the explosion pressures is eliminated. If any cylinder provided with a belt of exhaust or inlet ports is bolted down by its lower end, it is evident that the explosion pressures acting between piston and upper part of cylinder must create axial stresses passing through bridges between ports. If any shrinkage stress exists in the casting it is most likely to be found near these ports.

In an internal combustion engine stresses tending to burst the cylinder cannot be safely reduced by increasing the thickness of the cylinder walls, as each square inch of the wall, particularly at the upper end of the cylinder, must pass a large amount of heat to the water jacket in a very short space of time. The greater the wall thickness, the greater the consequent difference between the temperatures of the inside and outside surfaces of the cylinder walls. The greater such difference in temperature, the quicker a cylinder will fail, due to heat fatigue.

Avoiding Heat Fatigue Stresses

The practical success of an internal combustion engine depends upon the avoidance of such heat fatigue stresses, and the necessity of care and skill in the design of cylinders naturally increases with their size, since thickness of walls must increase with the diameters of power cylinders. To cover this point the Bethlehem power cylinder has been designed as shown in Fig. 5 and in larger scale in Fig. 6. It will be noted that the upper part of the cylinder is contracted from the diameter of the bore to that of the inlet valve cage. This form, as compared to an open ended cylinder, increases the strength without necessitating an increase in thickness of the walls.

It will be noted from Figs. 5 and 6 that the cylinder wall thickness is uniform in all that portion of the cylinder subject to maximum temperature and pressure, the thicknesses decreasing with the lower pressures in the lower part of the cylinder. Such uniformity in section causes uniform change in shape when heated.

The part of the cylinder subject to greatest heat is that

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portion between the lower end of the inlet cage and the portion of the wall covered by packing rings when the piston is at or near top center. By reference to Fig. 6 it will be noted that this portion is efficiently cooled by the water jacket, which extends to a point of the cylinder wall above the bottom of inlet cage. The hot cylinder walls, thus efficiently cooled by water, are also cooled on the inside surface by the scavenging air. This enters through a mushroom shaped scavenging valve. The shape of the cylinder is such that the incoming current of scavenging air passes directly along this heated wall surface, absorbing from it a material amount of heat in addition to that passing to the water jacket. The

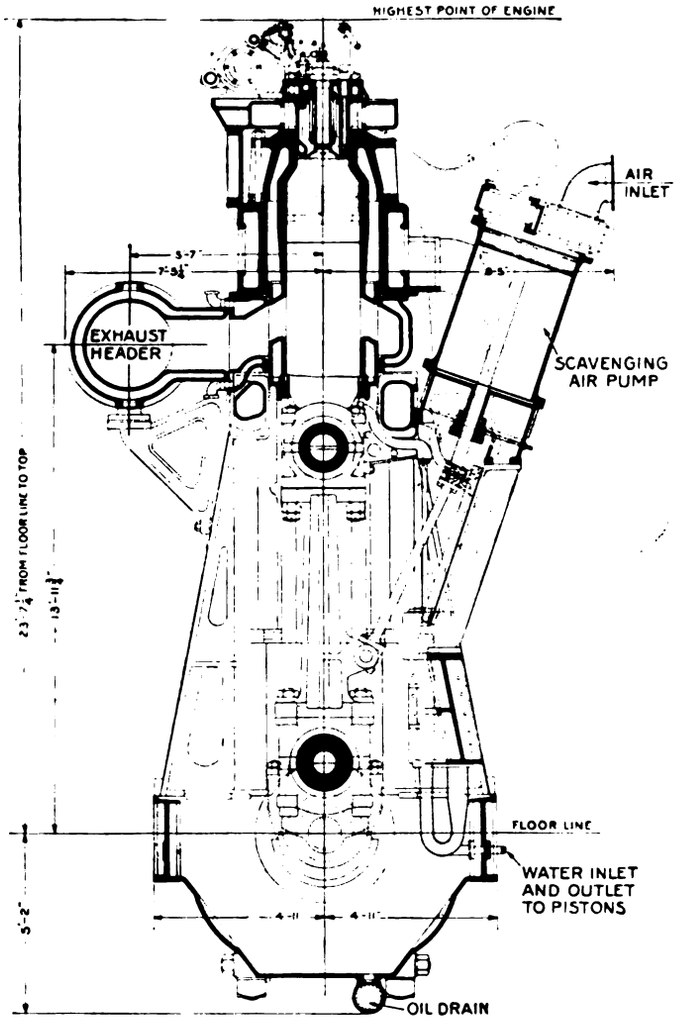

Fig. 5.—Section Through Engine

hottest portion of the cylinder walls is thus practically freed from the danger of heat fatigue for three reasons: Cylinder walls are of a very strong form, with moderate and uniform thickness in the upper portion; they are efficiently water cooled; the walls are positively air cooled on their inside surface by the scavenging air. It should be especially noted that cooling done by the scavenging air not only helps to maintain the cylinder wall at a safe temperature, but it also increases the efficiency of combustion, since all the heat absorbed by the air from the cylinder walls is added to the working cycle of combustion.

Other Heated Parts

It will be seen that the only other parts exposed to maximum temperature and pressure are the power piston, inlet cage, scavenging valve and fuel valve. Of these, the piston, inlet cage and fuel valve are water-cooled, while the scavenging valve is positively cooled by the incoming scavenging air, which thereby gains heat and efficiency in the same manner as described for the cylinder wall. The perfection of cooling of the scavenging valve and the seat against which it bears is well illustrated by the fact that during a period of more than three years operation of these engines at heavy loads no ill effects due to heat action on these have been detected. This is also true of the fuel valve.

Special attention is called to the fact that all parts subjected to heat, viz., cylinder, piston, inlet cage, scavenging valve and fuel valve are all exactly symmetrical with reference to the axis of the cylinder, each has a uniform wall

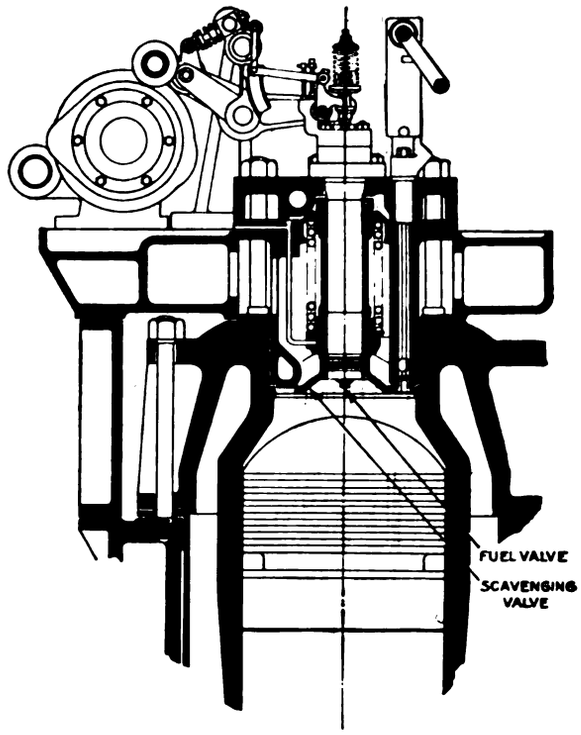

Fig. 6.—Section Through Cylinder Head

thickness and is efficiently cooled. Under the varying temperature conditions existing in the power cylinder these parts expand and contract uniformly and the heat is disposed of in a manner which entirely prevents heat fatigue of any part. During three years' hard service it has never been necessary to replace any part on this account.

Removal of Parts

It should be especially noted that all working parts except the piston, necessary for the operation of a power cylinder, viz., fuel valve, scavenging valve, air starting valves and relief valve, are contained in a single compact and easily removable cage, well shown in Figs. 7 and 8. Any practical man will readily appreciate the value of this construction.

General Construction

Each cylinder support contains a pair of power cylinders and rests on three A frames, to which it is rigidly held by six long bolts passing from top of cylinder support through A frames and bed plates. This construction is well shown in Figs. 5 and 7. When the engine is erected, these long bolts are tightened to produce in them an initial tension about 25 percent greater than the maximum tension arising from combustion pressure in the cylinder. The bolts are of such a size that this initial tension is not more than 20 percent of the elastic limit of the material. Since the initial tension in bolts is more than the maximum tension due to

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combustion pressure, it follows that the bolts do not stretch in the slightest degree while the engine is working and the A frames are therefore always in compression. Since the cylinders are held to the bed-plates only by these large bolts passing through the A frames, it follows that the latter are never subjected to tension. This construction gives the utmost rigidity without undue weight, as the cast iron A frames need be designed only for compression, the large bolts absorbing all the working stresses.

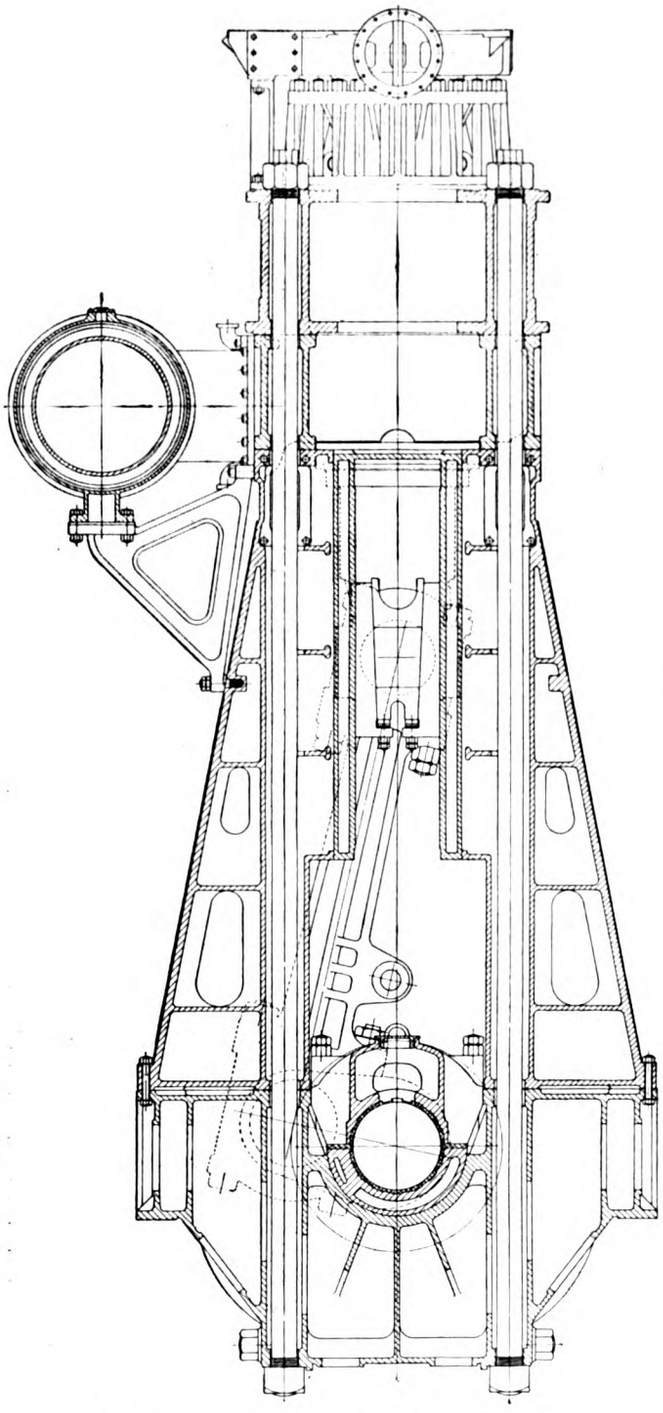

Fig. 7.—Section Through Engine Framing

In the usual oil engine construction, the power cylinders are bolted to the A frames, the feet of which are bolted to bed-plates near the outer edge. This arrangement subjects the whole width of the bed-plate to bending stresses arising from combustion pressures, with the deflection of the bed-plate consequent thereto.

BED-PLATE

By reference to Fig. 7 it will be seen that the large bolts pass clear through the bed-plate quite close to the main bearing, the distance from center to center of bolts being less than half the width of the bed-plate. Since the part of the bed-plate subject to stresses arising from combustion pressures is only the portion between these bolts, it follows that the span of bed-plate subject to such stresses is less than half, the stresses in the bed-plate less than one-quarter and the deflection of the bed-plate less than one-eighth of those encountered in the ordinary design.

The combustion pressures on the power piston, acting on the bed-plate, set up tension stresses in the lower side of the bed-plate between the large bolts. To resist these tension stresses, the bed-plate is provided in its lower part with the horizontal bolts shown in Figs. 5 and 7. During erection these bolts are subjected to an initial tension about 25 per-cent more than the maximum stress due to the combustion pressure. No deflection of the bed-plate can therefore occur and there is no possibility of a cracked bed-plate due to shrinkage strains. It will be seen that no part of either the A frames or bed-plates is subject to tension, such stresses being entirely taken by forged steel bolts.

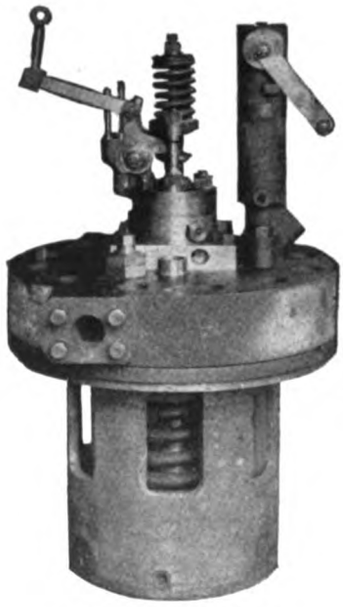

Fig. 8.—Valve Cage

Fig. 9.—End of Cage

SCAVENGING SYSTEM

Complete combustion in any oil engine requires that the power cylinders be efficiently cleared of exhaust gases. The clearance space in a four-cycle engine cylinder, amounting to about 7½ percent displacement, cannot be cleared of exhaust gases. Due to the fact that at the end of the exhaust stroke these gases must be at a pressure above atmosphere great enough to expel them from the exhaust pipe, it follows that in even the most carefully designed four cycle engine a material percentage of the suction volume of the cylinder is occupied by exhaust gases, the presence of which is necessarily detrimental to combustion. In this design of two-cycle engine the scavenging air enters through a central scavenging valve in the extreme upper end of the cylinder, forming an axial column which entirely fills the power cylinder and drives before it the burnt gases, which escape through exhaust ports located around the entire circum-

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ference of the lower end of the power cylinder. It will be evident that this construction must clear the cylinder of all burnt gases.

When using low grade fuels, a certain amount of residue is sometimes deposited on top of the pistons. With the arrangement described such residue is blown out into the exhaust passages before it has time to be hardened by heat. It should also be noted that with this system perfect scavenging can be obtained, no matter how long the stroke may be for a given cylinder bore.

The small bore, long stroke engine is more economical in fuel and lower in repair cost than an engine of the same cylinder displacement and piston speed, but in which the stroke and bore are more nearly alike, thus necessitating higher revolutions per minute. The gain in economy and repair costs by building an engine of a given horsepower of small bore, long stroke and low revolutions has always been evident in steam reciprocating engines, but is still more important in internal combustion engines, due to the higher temperatures and pressures necessarily employed.

For oil engines employed for marine service there is an additional reason for slow revolutions, as in this way a better screw efficiency can be obtained. For merchant ships single screws are cheapest and most efficient. It is worthy of note that the two-cycle engine is especially adapted to drive a screw because the efficiency of both engine and screw increases as the revolutions decrease.

Injection Compressor

Injection air is supplied by a three-stage air compressor driven from a special crank on one end of the crank shaft. Particular care has been taken in designing this compressor to assure reliability in continuous service under both land and marine conditions. The use of compressed air for fuel injection gives better atomization and combustion economy over a much wider range of fuels, particularly among the heavy and cheap grades, than any other injection system yet developed. The Bethlehem has been run with entire success, on distillate fuels down to 16 degrees Baumé.

To secure refinement of control and economy at all speeds and powers, a system of fuel valve lift control has been developed. This permits the lift of all fuel valves to be quickly regulated from zero to full lift at any moment by the operator when maneuvering the engine. The proper air and oil ratio may therefore be maintained under all conditions. When maneuvering a marine engine or when starting up a land engine, the injection air may be conserved and used in the proper amount, instead of in excess as is the case with a constant lift fuel valve.

Removal of Pistons

A simple device is furnished with the engine for removing pistons from the bottom of the cylinders without disturbing any of the valve gear or piping on top of the engine. The advantages of this construction have been proved by extensive operation under both land and marine conditions. This device is well illustrated in Figs. 10, 11, 12 and 13 showing successive stages by which access to power piston is quickly and conveniently obtained.

In selecting power units for ships, the ease and flexibility of maneuvering with the main engine should be given careful consideration. The Bethlehem oil engine is especially adapted to meet these requirements, due primarily to the simplicity of the reversing gear, to the fuel valve lift control and to the fact that fuel can be injected into the cylinders without having to shut off the starting air. This last advantage is of particular importance because the engine remains turning over with air until combustion takes place in a sufficient number of cylinders. The reversing gear is simple as there is only one cam shaft. The same set of cams is used for both ahead and astern operation, the camshaft being turned

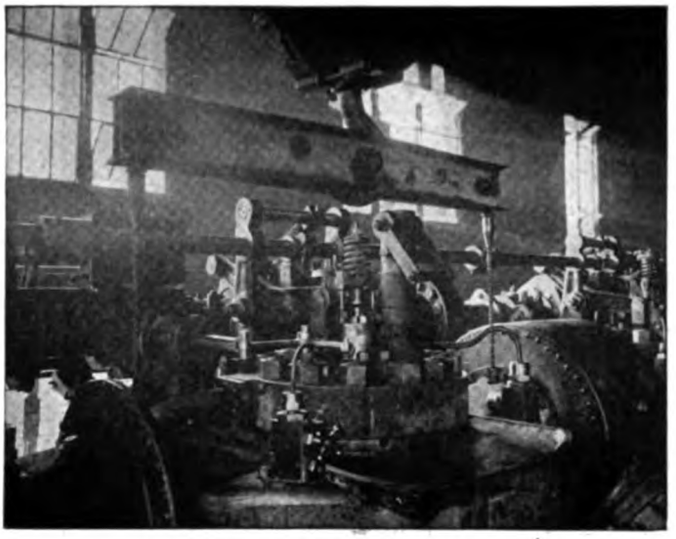

Fig. 10

by an air operated reversing gear for the proper timing of the valves in either direction. Reversal from full ahead to full astern may be accomplished in from ten to fifteen seconds, while positiveness and reliability have been proved under actual operating conditions.

The reversing gear and gage board are well shown in Fig. 14. The left hand lever admits starting air to all power cylinders, all of which receive fuel injection simultaneously. When combustion takes place the further ingress of starting air is automatically prevented. The middle lever controls the amount of fuel injected into the cylinders and works in a double slot somewhat similar to the selective gear lever on an automobile. The lever is shown in the left hand slot, in

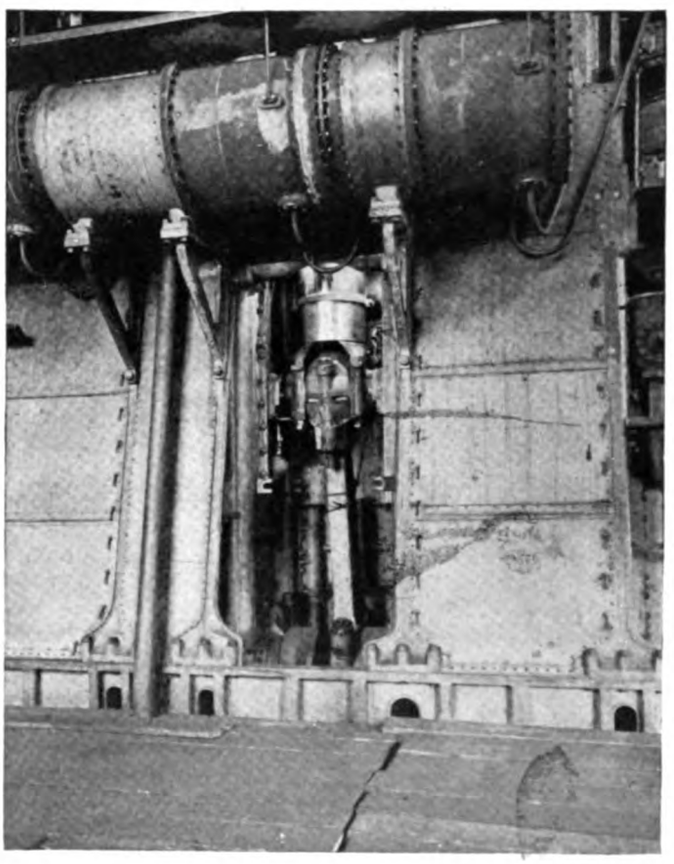

Fig. 11

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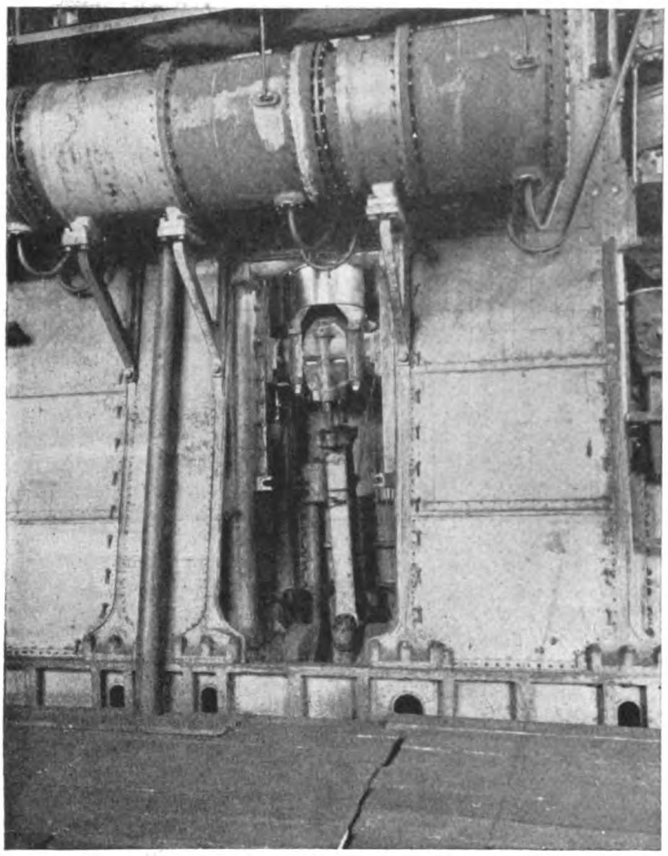

Fig. 12

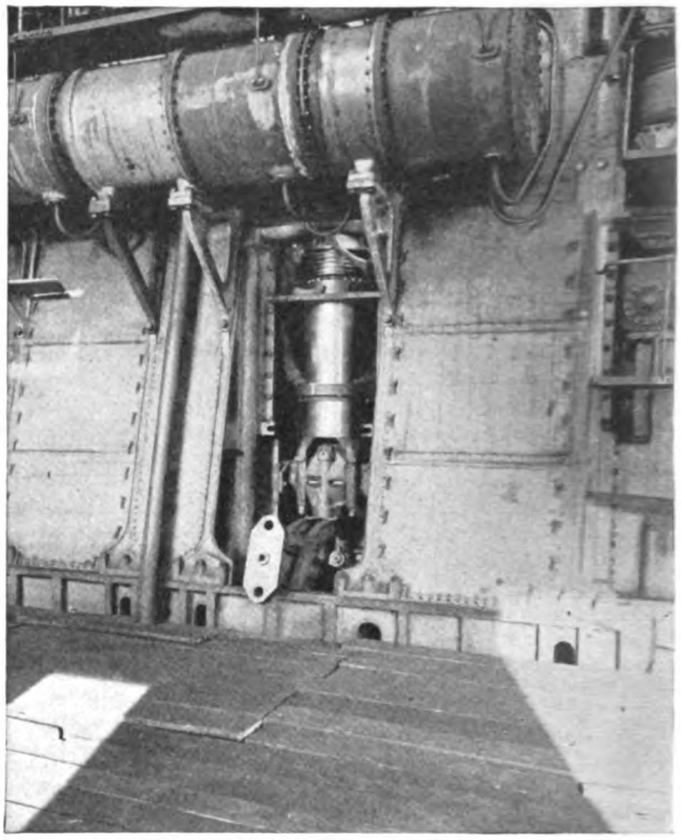

Fig. 13

which case it supplies fuel for operation ahead, the amount of fuel being increased by pushing the lever farther from the operator.

When the operator wishes to reverse he pulls the fuel lever toward him as far as he can. This shuts all fuel off the engine. He then moves the lever to his right as far as possible. This, by means of the valves shown, admits compressed air into an operating cylinder which rotates the camshaft so as to bring the cams into the proper astern position, in which position the gear is automatically locked. When the gear has moved into its extreme position, the lever may be pushed out into the right-hand slot, but the operator is prevented from doing this until the air interlocking device is moved out of the path of the lever by the action of the reverse gear completely reaching the end of its travel. The fuel lever is moved out into the astern slot far enough to give the desired power and the engine then goes astern when the operator moves the left hand air lever away from him. It will be seen that this reversing gear is fool-proof for the following reasons: The engine cannot be reversed without first entirely shutting off the fuel; the engine cannot be given fuel in the reverse direction until the reverse gear has completely moved into the proper position. The right hand lever determines the lift of the fuel valve so as to properly control the injection air at all speeds and powers, as previously explained. This arrangement has the additional advantage that the engine can, in case of emergency, be started without the necessity of charging the injection air bottles beforehand.

Scavenging Compressors

The scavenging compressors are arranged on an incline, and are driven from main connecting rods, as shown in Fig. 5. The scavenging pistons are very light, being made of an aluminum alloy. The scavenging piston rods are also light, being hollow. Due to its lightness the scavenging piston bears very lightly on the lower side of cylinder wall. After 15 months' continuous operation it is impossible to detect any more evidence of wear on the lower side of the scavenging cylinder than on the upper side. Since the total forces due to one scavenging compressor are less than 2 percent of those passing through the main connecting rod from which the compressor is driven, it is evident that no more wear will be found on this main crank pin than on the others. Fifteen months' operation have actually proved this to be the case.

This inclined scavenging compressor drive has been proven by long continued hard service to be an unqualified success. Its advantages are manifest. It does not lengthen the main engine an inch and still more important, it does not increase the number of crank-shaft bearings which must be kept in line. This detail is especially important on a ship. Furthermore, this arrangement of scavenging compressors does not take up any floor space, does not increase the height of the engine, and does not materially increase its weight. These points are all important on a ship.

Engine Based on Unit System of Design

The general design of the engine is based upon the unit system, each unit consisting of two power cylinders, cylinder support, A frames, bed-plate section and crank-shaft section. This enables the engine to be built as a two, four, six or eight-cylinder motor by combining these units. The crank-shaft sections are interchangeable, each consisting of two cranks set 180 degrees apart together with flanges on each end, forming an integral part of the shaft. The timing of cranks needed for different combinations of cylinders is obtained by the manner in which the shaft sections are bolted together.

The construction of the section with the cranks opposite has two advantages. First, the inertia forces of the reciprocating parts attached to these cranks are, except for the

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angularity of the connecting rod, equal and opposite. The vertical planes in which these opposing and counterbalancing forces act are closer together than is possible with any other crank arrangement. The comparative closeness of these planes of action therefore keeps down to a minimum the tendency in a ship to produce periodic vibration. The *Cubore,* having a six-cylinder engine, is for this reason remarkably free from such vibration.

The second advantage in constructing a shaft section with two opposite cranks is very important from a practical point of view. The whole crank-shaft section is in one plane, from which it results that on a six or eight-cylinder engine a center section of crank-shaft can be removed end-wise without disturbing either the other crank-shaft sections or any part of the A frames. As previously described, the injection air compressor is driven from the forward end of the engine. To preserve the interchangeability of crank-shaft sections, the small crank driving the injection compressor is bolted to the forward flanges of the forward section.

TEST BY ENDURANCE RUN

To prove the reliability of the Bethlehem engine a 30-day continuous endurance run was made with the six-cylinder engine now being regularly used to generate alternating current for steel mill service in the Bethlehem plant. The engine functioned perfectly, and at the end of the run was thoroughly inspected and found to be in excellent condition. The following data give the average results of the test:

1.	Duration	730 hours, 35 minutes
2.	Total revolutions	5,057,997
3.	Average revolutions per minute	115.3
4.	Total kilowatt hours produced	1,211,900
5.	Average kilowatt load	1,659
6.	Average brake horsepower	2,522
7.	Average indicated horsepower	3,582
8.	Average mechanical efficiency	70.4%
9.	Total pounds fuel oil consumed	849,829
10.	Average pounds fuel oil per kilowatt hour	0.70
11.	Average pounds fuel oil per brake horsepower hour	0.46
12.	Total gallons bearing oil consumed	716.0
13.	Total gallons cylinder oil consumed	189.5
14.	Total pounds cup grease consumed	158.5
15.	Average gallons bearing oil per hour	0.98
16.	Average gallons cylinder oil per hour	0.25
17.	Average total gallons lubricating oil per hour	1.23
18.	Equivalent sea mileage of total revolutions	8,700

Note—Ordinary plant fuel oil was used, varying from 22 degrees to 30 degrees Baumé, with high sulphur content.

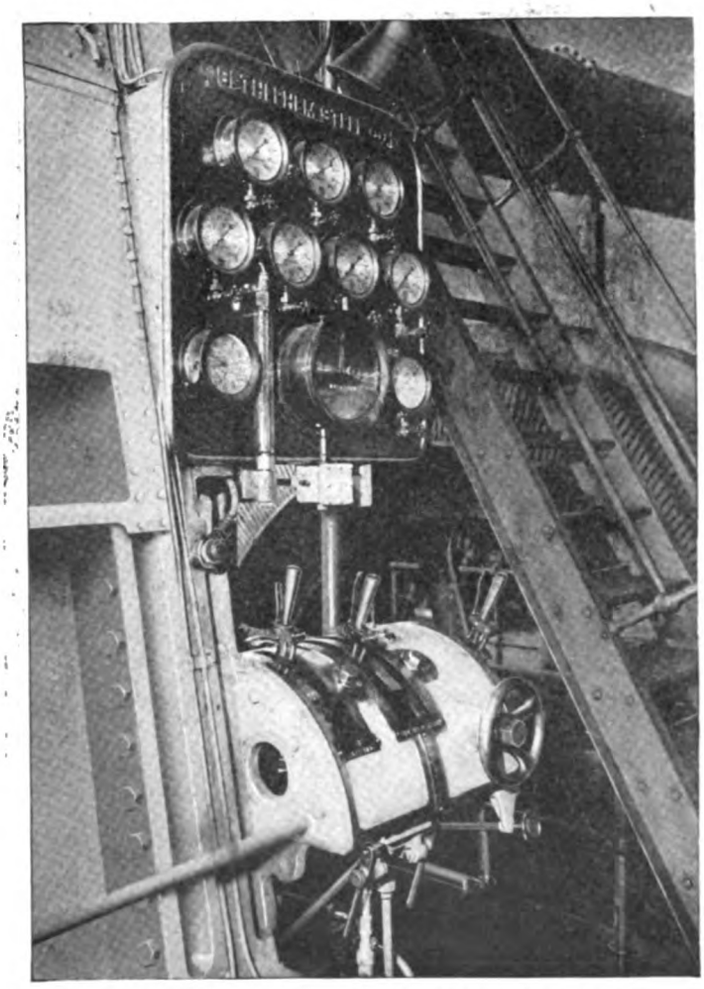

Fig. 14.—Reversing Gear and Gage Board

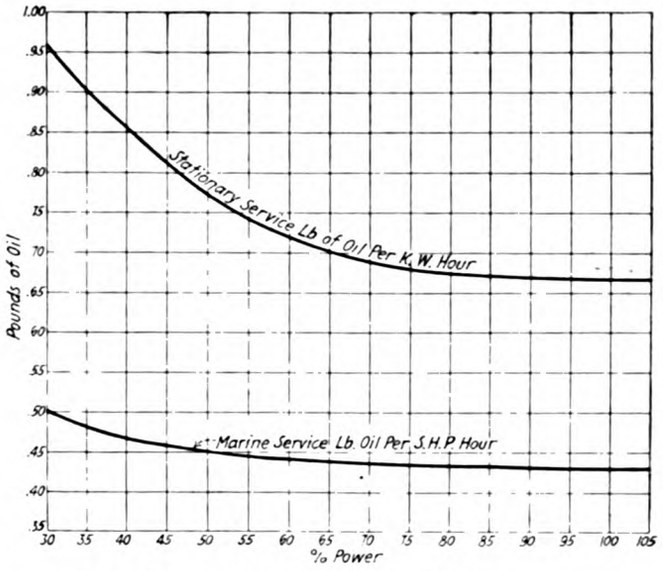

Fig. 15.—Fuel Consumption of Bethlehem Engine

RATINGS OF BETHLEHEM OIL ENGINES

The ratings of the Bethlehem oil engine are given in the table below. These ratings are conservative and are based on operation of the engine in severe, continuous service.

Number of Cylinders	Stationary or Twin-Screw Marine Service: Revolutions Per Minute	Brake Horsepower	Kilowatts	Single-Screw Marine Service: Revolutions Per Minute	Brake Horsepower
4	116	1,950	1,300	90	1,600
6	116	2,900	1,950	90	2,400
8	116	3,900	2,600	90	3,200

First Electric Oil Barge on Atlantic Coast Has Successful Trials

THE *J. H. Senior* has the distinction of being the first Diesel electric barge on the Atlantic Coast and is the first of her kind owned by the Standard Oil Company of New Jersey. She was launched on January 5 by the Newport News Shipbuilding and Dry Dock Company and the sea trials were held on February 22 off Norfolk.

The two McIntosh and Seymour Diesel engines driving two Westinghouse 185-kilowatt main generators and 35 kilowatt auxiliary generators and exciter units, and also the 445 horsepower Westinghouse propelling motor, after six hours of running, were run at both 10 and 25 percent in excess of rated power for a half hour period. Quick reversing from full speed ahead to full speed astern, the maneuvering tests, etc., exceeded expectations. All of the electrical driven auxiliaries including cargo oil, sanitary, bilge, fuel oil transfer, circulating water, fire and bilge and general service pumps, etc., stood satisfactory tests. The pilot house control was used in starting and again for docking without signalling the engine room crew. The *J. H. Senior* is 210 feet long, 38 feet wide and has a capacity of 11,000 barrels of oil at a 13 foot draft. She will operate in the Chesapeake Bay Service.

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Diesel Engine Developments in Germany

Twelve-Thousand Ton Liner To Be Fitted With Geared Drive—Details of Fottinger Hydraulic Coupling System

By Our Special London Correspondent

IN Germany, very much the same degree of interest is being shown in the possibilities of geared Diesel ships, as is to be noted in America in connection with the Diesel-electric drive. The objects in view are somewhat similar, as in most cases relatively high speed and consequently light-weight Diesel engines can be utilized, while the propellers can have a low and efficient rate of revolution. Moreover, non-reversible oil-engines may be employed, and to obtain high power, a number of Diesel motors can be installed, even with a twin-screw installation.

A 12,000-Ton Gear Driven Liner

It is probable that one of the reasons why gearing is preferred to the electric drive is that the total cost is considerably lower and it is apparently necessary in Germany to build new ships with the absolute minimum of expenditure. It is significant that one of the biggest liners to be constructed in that country since the war—a 12,000-ton vessel for the Hamburg-South America Line—which will be completed during the course of the coming summer, is to be a twin-screw vessel propelled by four Diesel engines each of 2,500 brake horsepower driving through gearing on to two propeller shafts.

The engines will run at something over 200 revolutions per minute and the propellers at about 100 revolutions per minute and it is stated that the reduction in weight as compared with a direct-Diesel drive is very considerable. No doubt this plan would not have been adopted had not the builders, Blohm & Voss been satisfied with the experience gained by the two 11,000-ton cargo ships which they constructed on the same principle for the Hamburg America Line a year or two back.

The Föttinger Hydraulic System

A still more interesting development—and it is one that has aroused the greatest interest among engineers and shipowners in Europe—is the new Föttinger system which has just been brought to a practical stage by the Vulcan Works at Hamburg. It is claimed, perhaps rightly, that when a Diesel engine drives a propeller shaft through gearing in the ordinary way, this gearing is subjected to shocks which it is impossible entirely to eliminate, even if a flexible coupling is provided.

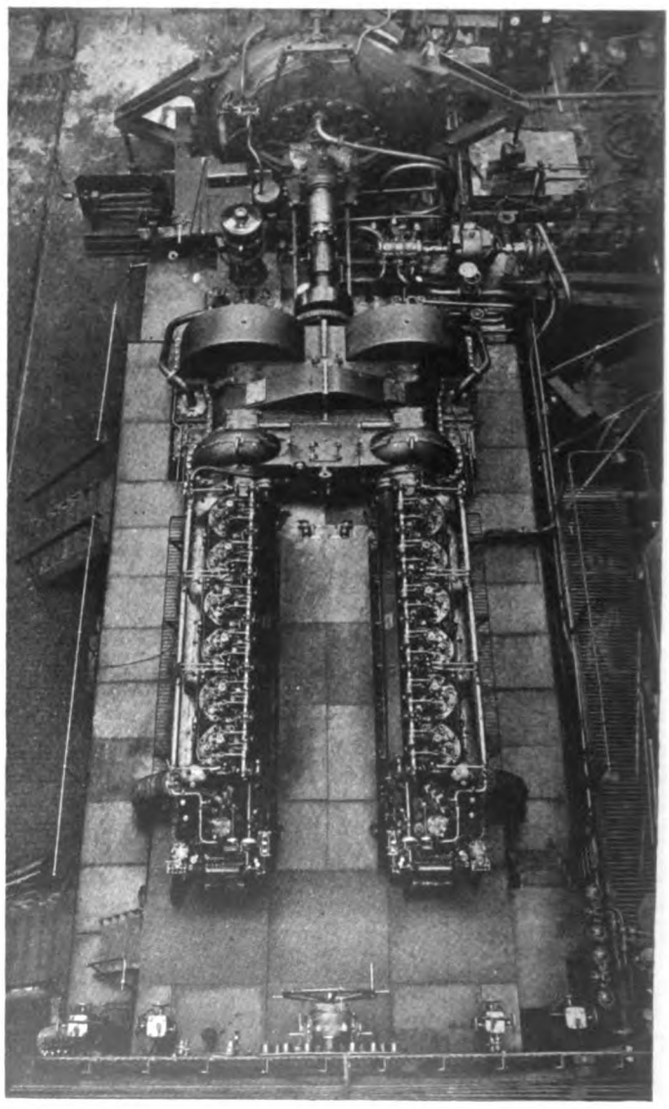
The arrangement employed by the Vulcan Works is to interpose hydraulic coupling between the engine shaft and the gearwheel. The whole of the speed reduction is effected by the gearing and not by the hydraulic coupling which merely serves to give complete elasticity to the drive and thus to prevent any trouble arising in the gearing itself. Separate couplings are provided for the ahead and astern drive so that the engines themselves are of the non-reversible type.

Several other advantages are claimed. When maneuvering, no compressed air is needed for starting the engine, since it can run light by merely discharging the fluid from the couplings. With a twin-screw installation, four or even eight engines can be utilized, so that very high-powered motor ships can be built without the necessity of adopting higher powered engines than those that have already proved their reliability.

The saving in weight is considerable as compared with the normal drive. The total machinery weight of a 9,500-ton cargo ship equipped with two 2,000 brake horsepower engines running at 285 revolutions per minute and driving the propeller shaft at 105 revolutions per minute is 717 tons, against 1,138 tons with direct-coupled engines. Plans have already been prepared for the construction of a large motor passenger liner with machinery of 20,000 brake horsepower developed by eight Diesel motors each of 2,500 brake horsepower running at 250 revolutions per minute. There would be only two propeller shafts operating at 80 revolutions per minute.

The First Vulcan-Geared Ship

Late in January, the first ship in which the new Vulcan system will be tried, was launched at Hamburg. She is a vessel of 2,000 tons deadweight, 230 feet in length with a beam of 36 feet and a draft of 16 feet 2 inches. Two submarine type high-speed engines totalling 620 brake horsepower are installed. They operate at 300 revolutions per



The First Vulcan Hydraulic Geared Diesel Installation for a 2,000-Ton Cargo Ship

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minute and drive the single propeller shaft at 85 revolutions per minute the speed of the ship being 9½ knots.

The general arrangement of the machinery is indicated in the accompanying illustration which shows the two engines and gearing coupled to a waterbrake, in the Vulcan Works. The manufacturers attached such importance to this development that they gave demonstration trials of the plant through practically the whole of January and these were attended by representatives of many of the prominent European shipowning firms.

For each Diesel engine there is an ahead and an astern coupling, the former being aft and the latter close to the engine. Between them is the pinion driving on the gearwheel on the propeller shaft. The Diesel engine shaft passes through the pinion wheel and is attached to one impeller in the ahead and one in the astern coupling. A second impeller in each coupling is keyed on to the shaft of the pinion wheel itself.

When the engine has a drive in the ahead direction, the working fluid, which is lubricating oil, is removed from the astern coupling, but the ahead coupling is full. The reaction of the impeller on the Diesel engine shaft, causes the impeller on the pinion shaft to rotate and thus drives the propeller shaft at practically the same speed, the slip being perhaps 3 or 4 percent. If, by means of a wheel at the control station, the working fluid is removed from the ahead coupling and pumped to the astern coupling, a corresponding action takes place. There are however fixed guide blades in these couplings which cause the fluid to be diverted so that the pinion shaft is driven in the opposite direction.

The working fluid is circulated through the system and discharged or delivered to the couplings as required through a separate electrically-driven pump and the whole control is effected by means of one large handwheel at the starting platform. Variation of speed is carried out on the Diesel engine in the normal manner and it will be realized that the couplings attached to the two engines can be brought into action together or separately as desired.

It is not essential that lubrication oil should be employed as the working medium. In large installations it is proposed to have water for this purpose. In small plants however it is convenient to adopt oil which can be used at the same time for the purpose of lubricating the mechanical gearing.

The efficiency is higher than might be anticipated and amounts to 95 to 96 percent, according to the tests that have been carried out. For this reason it is claimed that the new system is superior to the electric drive where the overall loss is generally in the neighborhood of 12 to 15 percent.

It is understood that the Vulcan Works are now proceeding with the construction of a big vessel with machinery of 8,000 brake horsepower in which the Föttinger drive will be adopted. It should be noted that this is not similar to the Föttinger hydraulic system of propulsion developed by Dr. Föttinger for employment in conjunction with turbines and which has been known for some years past.

The Maintenance and Care of Diesel Engines

Practical Notes on the Operation of Diesel Engines, Compressors and Motorship Auxiliaries

By Oscar Olson*

MY experience with the Diesel engine has been the most interesting and pleasant of my seagoing career. I have spent twenty years at sea with steam engines, during which time I also took a great interest in the progress of the internal combustion engine and I am glad I did, because the steam engines have become victims to circumstances, and must leave the field, to the much more economical prime mover, the Diesel. The time is not far off when all steam machinery will be placed on the shelf as a memorial of a useful device, which has served humanity well.

The amount of work necessary for the proper upkeep of steam or Diesel engines of equal power, will be about the same, however different in nature. With a steam plant there is lots of work in connection with the boilers, such as keeping them clean, that requires little or no mechanical skill, outside of the scientific methods employed for treatment of feed-water and the intelligent use of apparatus to determine proper combustion, which will somewhat lesson the accumulation of dirt, and lengthen the time between periodical cleanings. Work in the engine room of the two types of ships requires mechanical skill in both cases.

Fewer Men in Diesel Engine Staff

There are fewer men employed in the engine room department of a motorship and with the numerous jobs under way while in port, some of which only requires the attention of one man, it can readily be seen how essential it is that every member of the crew should possess some mechanical skill. Bearing troubles with Diesel engines are unknown, provided they are properly fitted and adjusted, as the bearing surfaces are large and the force feed lubrication is very liberal.

It is a well known and recorded fact, that motorships have been in operation for four years without having to make any adjustments to either crank pin or main bearings but of course if such ideal conditions are to be obtained, the lubricating system must be kept in an efficient state and the oil carefully handled. Cleanliness and good workmanship are essential in almost all work on Diesel engines and above all things the adjustments must be correct.

There are special tools furnished by manufacturers of Diesel engines, to better enable the engineers to handle the work. These should be kept clean and in good order and placed in racks so as to be handy at all times. The air compressors have been given undue criticism, by some people and steam engineers breaking into the Diesel game will at first look on them with suspicion, and almost every visitor who comes on board will invariably inquire: "How is your air compressor?"

Compressor Maintenance

If the volumetric clearances are correctly maintained, valves carefully ground in, piston rings properly fitted and air coolers kept in an efficient state, all the compressor will require is a small quantity of good lubricating oil and it will work faithfully and uncomplainingly for one thousand working hours, when opened up after this period, it shows very little wear on the valves. It is therefore safe to assume that it would run much longer if necessary. However, I try to

*Chief engineer, motorship *Seekonk*.

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make periodical inspection and overhaul the valves after one thousand hours, and I find that it works very well. Every two years I open the compressor, lift the pistons and make a thorough inspection of everything and also change rings and make necessary overhaul.

The Inspection Bureau requires that the main engine pistons be lifted every two years for survey. The size of the plant therefore governs the number of pistons to be lifted at certain intervals, in order that all cylinders may be periodically inspected during the stated time.

If materials of cylinder liners and piston rings are of good quality and good workmanship is practiced in fitting the rings, there should be no occasion to lift a piston before its inspection is due, provided the fuel used is of reasonably good quality and the cylinders receive their proper amount of lubrication. It must be understood, of course, that all foreign substances having a detrimental effect on the cylinder walls, must be kept out, for instance salt water leaking from the telescopic tubes employed for piston cooling, will cause a leaky piston quicker than anything I know of.

Periodic Inspection

It will be seen therefore that the engineer can pick the most suitable time for the mentioned inspection, as long as it is inside the prescribed limits and it can be taken care of in foreign ports as well as at home, because the American Bureau and Lloyds both have representatives in most principal sea ports. I have found all of them very accommodating whenever I have had the occasion to enlist their services.

By splitting up the inspection and taking one, two or more cylinders, as the case may be, it is easier on the engine room force, besides preventing unnecessary delay of the ship.

The durability of the fuel and exhaust valves (providing reasonably good fuel is used) is entirely up to the engineer in charge. If the specified mean effective pressure is carried they will last a long time, before they need changing and I have personally made sixteen thousand miles with one set of valves, and when changed after that time, they were all in good condition and would have lasted for a considerable time longer.

Intake and starting valves I lift once a year for inspection and overhaul and I find they require very little work.

Care of Auxiliary Engines

The auxiliary engines require more care and attention than the main units, owing to their high speed and the great variation in loads. The manufacturers generally recommend a maximum time limit between periodical inspection and changing of valves, of three hundred hours of operation. I have extended this limit one hundred percent. First I started with four hundred hours, next five hundred, and after that six hundred hours, which I have established as a period between each time that valves are changed and overhauled, and I find no more work after six hundred hours of operation than I did after three hundred.

In my opinion, the engineer in charge is the best judge of how often the valves should be changed, as he is shipmates with the machine, knows how much work it is doing, the care it gets, and last but not least, what kind of fuel is used and what effect, if any, it will have on the engine. Once a year at some opportune time they are opened up for general inspection and necessary overhaul, everything is dismantled and closely checked up for wear, all of which is recorded for future reference. This yearly inspection will take two men four days to accomplish and the changing of valves, which should be done every six hundred hours, will take one day, which is conservative.

The other auxiliaries in the engine room, which are all electrically driven, are about seventy-five percent easier to take care of, than steam driven of the same size and power, and what is more they run quieter, maintain a more uniform speed and the temperature in their close proximity is from 30 to 50 degrees less.

Lubricating Requirements

There seems to be a varied opinion among engineers, as to the right amount of lubricating oil to be used in Diesel engines, I will therefore give in detail the exact amount used per 24 hours for the motorship *William Penn's* engines having an indicated horsepower of 4,500.

Cylinder lubrication	9 gallons
Compressors	1 gallon
Telescope wick feed	1½ gallon
Telescope swabbing	¾ gallon
Hand lubrication	½ gallon
Thrust and tunnel bearings	1 gallon
Cylinder lubrication for one auxiliary engine	1 gallon
Hand lubrication for auxiliary engines	⅛ gallon
Other auxiliaries in service	⅛ gallon

Making a total consumption of 15 gallons for all purposes. The motorship *Seekonk's* engine is only half the power of the *William Penn's*, or 2,250 horsepower. The consumption therefore should only be 7.5 gallons, but on the first voyage the consumption is generally heavier and our daily consumption will perhaps average around 8 gallons. The above amount seems to have been plenty, as everything operated very well at all times, without showing any undue wear in any place.

I am not writing this in anticipation of having it held up as a standard to follow, I am merely relating my personal views on a very much discussed subject among operating engineers.

There is a lot to be said about fuel oil, but I will leave that to some one else, or to some other time, and all I will say is that I have yet my first trouble to meet, but I have taken all precautions to guard against the two most common evils, sediment and water, by close personal observation of the condition and handling of the daily supply tanks.

I have compared the amount of work in steam and Diesel engines, and I hope that I will not be misconstrued, and have someone think that an engineer's position on a motorship is a bed of roses. There is plenty of work for all to do, but by formulating a system of routine work, close cooperation, with direct line of authority, it can be well taken care of.

I am a firm believer in the Diesel engine, and as to its reliability there is not a question of doubt, it is a good shipmate, and any steam engineer who has sailed to sea in his licensed capacity can easily adapt himself as an engineer on motorships, because there are no mysteries in connection with the internal combustion engine.

Electrical Method of Flue Gas Analysis

AN electrical method of gas analysis recently perfected at the Bureau of Standards of the Department of Commerce makes possible the immediate detection of the change in composition of flue gases in a boiler plant, the recording of such changes throughout the day, and the manual or automatic control of regulating apparatus in accordance with the gas composition.

The new apparatus makes use of the fact that different gases have different rates of conducting heat. Consequently if an electrically heated wire is surrounded by the gas, the rate at which the wire loses heat, and hence the temperature it will maintain, depends upon the composition of the gas. Change in temperature changes the electrical resistance of the wire, and makes possible the recording of the changes by electrical means.

This device and tests made of it are described in Technologic Paper No. 249 of the Bureau of Standards.

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Water Rates of Geared Turbines

Design and Operating Factors of Impulse, Reaction and Combined Impulse Reaction Turbines Tending to Increase Economy

By H. E. Brelsford*

THE problem of determining the water rate or economy factor of a steam turbine is relatively much simpler than the like determination for a reciprocating engine although it is influenced by as many factors. There are three general and common types of turbines in use now, all of which may be either direct connected to the propeller shaft, or connected through reduction gears:

The straight impulse type, which may have all the wheels with a single row of buckets, as in the Rateau design, or may have one or more wheels with a double row of buckets, which is commonly called a Curtis wheel or stage. Strictly speaking, this is a velocity stage and is used to permit quickly dropping the initial steam pressure.

The straight reaction type as commonly built by Parsons. This type is made with a drum type of rotor and has a large number of stages or expansions through which the steam expands uniformly.

The combined-impulse reaction type as made by the Westinghouse Company. This construction involves a Curtis velocity stage wheel which receives the steam as it emerges from the first nozzles. The steam emerging from this wheel enters the reaction blading mounted upon a drum as in a regular reaction turbine.

Mechanical Advantages of Three Types

Each of the aforesaid types possess common characteristics, and each also possesses points of advantage over the other, mostly, however, of a mechanical nature rather than from an economy standpoint. For instance; steam velocities through a straight impulse turbine as practically constructed will be high, hence the question of erosion is involved.

In the second type, steam velocities are low throughout the turbine and the question of erosion is not present.

In the third type, steam velocities are high through the Curtis wheel, but low throughout the remainder of the turbine and equal to the straight reaction turbine.

Blade clearances in the first are large and in the other two very small. For the same economy, horsepower, steam conditions, and revolutions per minute, the first type will occupy the greatest space, and the third the least space. For any given present day horsepowers the design of all three can be such that there is no appreciable difference in economy of fuel and no serious difference in size.

The problem therefore settles down to one of adaptation to the mechanical arrangement and space required, together with the ever present consideration of maintained reliability.

After several years' experience and contact with the men at the top of the turbine profession and numbering many who muster behind each of the three types of construction referred to, I do not know of one who would undertake to prove that his particular choice was both the most reliable and economical construction or design.

The many adherents of the impulse turbine say it is by far the most reliable because of its large clearances, which permit it to endure more general abuse during operation, without destruction of parts when correct adjustments are not maintained. Buckets are heavier and more rugged and the rotating structure being built up of disks and wheels, the shaft can be made more uniform and is less apt to distort through unequal heating. By the choice of proper blades material erosion is minimized.

The adherents of the straight reaction type say their construction for identical economy is more compact and for that reason less apt to damage from outside forces. The rotor being of a drum or solid spindle construction is stiffer and more rugged, hence will run true and be less affected by vibration. The steam velocity being low, there is no erosion of blading even with much less expensive material than the first type of turbine. The lack of erosion and great number of expansions will mean maintained economy.

The adherents of the third or combined impulse reaction turbine claim equal power and economy in smaller space, thus still greater reliability. The rotor being of a drum construction with the Curtis wheel forged directly on it gives a very rigid rotor structure, hence is less affected by vibration forces. Any decreasing efficiency of the Curtis wheel by erosion only affects the turbine slightly because of the maintained efficiency of the reaction blades through which the steam acts during the remainder of its passage. In addition, they can also claim that in case of distortion of whatever kind causing the blades to rub, either the case or each other, only the reaction blades will be damaged, as the large clearances on the Curtis element will effectually protect it from damage. This being a fact, the turbine will still be able to produce power up to approximately 50 percent of normal as usually designed, which is a very important factor.

Relative Standing of Claims

All of the above claims are true and have been substantiated, yet after all, due consideration will give these facts such ratings as to make the relative standings about equal. Consideration of the other side of each type will show that the impulse turbine is affected by both erosion of blades and interstage leakage and with the use of any material will require periodic though infrequent renewals.

The close clearances on the reaction turbine require perfect maintenance or else damage will occur to blades due to bearing or dummy balancing piston wear, either of which may cause quick destruction of the blading or excessive leakage. Very frequently the advantage of proper design is lost, due to the fact that the operating department will increase blade clearances by machining the tips in order to lessen the chances of damage, hence the designed economy is not obtained. Each 0.010-inch blade clearance on an average 3,000-horsepower unit will lower the efficiency 1 percent. This latter item is also true of the combined impulse and reaction type and, in addition, its economy is affected by erosion of the blades on the Curtis element.

Erosion can be largely eliminated by proper installation arrangements and by proper operation. The use of large sized steam separators in the steam lines will go a long way towards stopping erosion due to the mechanical action of water in the steam, but will not, of course, compensate for the moisture due to low steam quality in the last stages of a turbine. The proper attention to drainage of the turbine case and maintenance of water level in the boilers will also greatly decrease erosion.

The danger of stripping buckets in the reaction or com-

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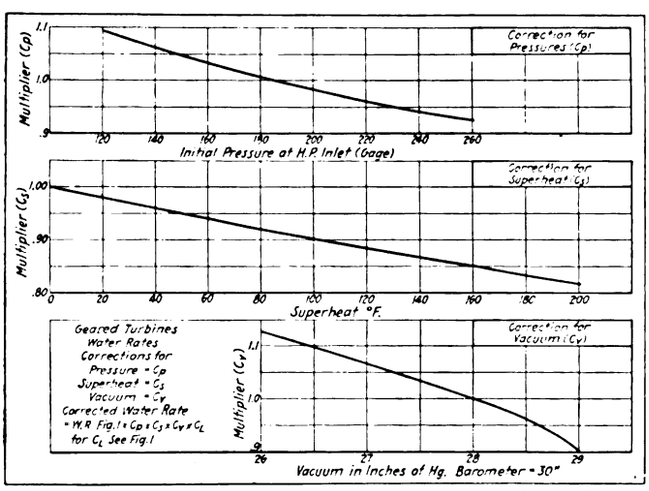
bined impulse reaction type is almost nil if the bearings are provided with squealer devices and the engineer is really competent, maintains good lubrication and frequently checks the rotor setting both fore and aft and vertically; hence the importance of end position and bridge gages.

Choice of Turbines

The choice of the type turbine to use in any ship is therefore not based upon its intrinsic properties alone, but largely by the service the ship is to be put into and the operators who will handle the ship. There have been but very few instances where an effort has been made to get the maximum economy possible and all too often an installation is handicapped by space and first cost considerations or due to lack of complete study. By the use of non-corrosive alloys, fine grade semi-steel casings, cast steel high pressure ends and accurately proportioned rotors, the use of very high pressures, superheats and vacuums will give economies better than present practices of around 35 percent.

There are but few turbine ships equipped with adequate condensers, consequently turbines run with 28 inches vacuum or often less, whereas they could be operated on 29 inches at a gain in economy of 8 to 10 percent, assuming that the last stages are designed for large steam volumes. Tests made on many ships have shown a loss of vacuum due to inadequate exhaust pipe or trunk of from ½ inch to ¾ inch of mercury. This connection should be as short and ample as it is possible to make it, with a maximum velocity of not over 250 feet per second at the turbine end, and 150 feet per second at the condenser end.

Many ships have been built with an exhaust connection which maintained a velocity of over 600 feet per second. For powers up to 6,000 per shaft, it is by far the most desirable to use gearing so arranged as to place the driving turbines up high and mount the condenser directly under the turbine. This gives a very direct connection, eliminates


Correction for Pressures (Cp)
Multiplier (Cp)
Initial Pressure at H.P. Inlet (Gage)
Correction for Superheat (Cs)
Multiplier (Cs)
Superheat °F.
Geared Turbines Water Rates
Corrections for
Pressure = Cp
Superheat = Cs
Vacuum = Cv
Corrected Water Rate = W.R. Fig. 1 x Cp x Cs x Cv x CL for CL See Fig. 1
Correction for Vacuum (Cv)
Multiplier (Cv)
Vacuum in Inches of Hg. Barometer = 30"

Figs. 1 (Upper Curve), 2 (Middle Curve) and 3 (Lower Curve)

vacuum loss and gives perfect drainage so necessary to a turbine, but so often neglected.

Less Economy with Low Steam Pressures

Fig. 1 shows the decrease in economy with low steam pressures, hence shows the advantage of designing a ship for high pressure and also shows the necessity for having a flexible turbine by building it with several groups of hand-controlled nozzles. Many turbines have been designed with no hand-controlled nozzles or else only 20 percent control and it is therefore necessary to throttle the steam supply when running slow as up a narrow channel, or when light, with resulting poor economy.

The light load economy is very much better in an eight-stage turbine than a four stage, which is an important point to note. Every precaution should be taken to see that a ship can run with full pressure and maximum vacuum under every condition in order to secure great average economy.

Fig. 3 shows the loss of economy with lowered vacuum, and Fig. 2 shows the loss with decreased superheat. Maintenance of superheat may be provided for by a good soot blower installation in the boilers and it is more easily maintained than any of the three other conditions. Fig. 4

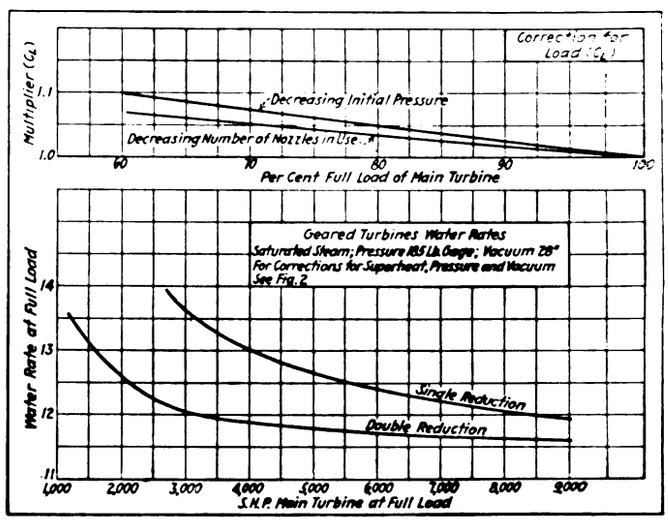

Correction for Load (CL)
Multiplier (CL)
Decreasing Initial Pressure
Decreasing Number of Nozzles in Use
Per Cent Full Load of Main Turbine
Geared Turbines Water Rates
Saturated Steam; Pressure 185 Lb. Gage; Vacuum 28"
For Corrections for Superheat, Pressure and Vacuum See Fig. 2
Single Reduction
Double Reduction
Water Rate at Full Load
S.H.P. Main Turbine at Full Load

Fig. 4

shows the economies of present-day turbine installations and is practically representative of actual conditions on a very great number of ships. At the top of Fig. 4 is shown the connection for partial load economies.

The Reversing Element

To my mind, the reversing element should be a single wheel in every case, whether the turbine is an impulse or reaction type and in the case of a cross compound or triple expansion turbine at least two reversing elements should be provided in two turbines. One thing that I feel is important is that the steam be led through the reverse element so as to maintain the thrust in the same direction as when going ahead, or else provide a balancing arrangement to accomplish the same thing. It has happened very frequently that the turbine thrust has worn while going astern due to dirt or grit that may have worked in while the turbine was going ahead. As turbines have been constructed it is hardly possible to check clearances frequently enough to be sure this has not happened. When going astern, therefore, the rotor shifts forward and the relation of the moving buckets to the stationary ones or nozzles is such that the slightest contact will cause them to lock together and strip.

An alternative to the above would be to make better provision for checking the position of the turbine rotor and to arrange so this could be done without stopping the turbine. Some attempts have been made along this line, but in every case the device was such that it lost its accuracy the first time it was used, so was practically useless.

An effect that is not generally known is the heating of the ahead elements when going astern due to windage effect where the full vacuum was not maintained on the ahead element. This trouble can only be provided for by separating the astern element from the ahead, or by providing large exhaust clearances.

Many so-called mysterious troubles have been occasioned by operating turbines with the astern steam valve leaking or

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not entirely shut off. In this case negative work is done with the result that very excessive high temperatures are reached that cause sufficient expansion to produce a rub and cause damage. I feel that this possibility is so great and sufficient cases have actually happened to require the practice of putting in an additional shut-off valve in the astern steam line to be closed when running ahead except during maneuvering.

In order to safeguard the astern operation of a turbine and keep the ahead operation highly efficient, the astern element must be as small and simple as possible to cut down windage. When steam is first admitted, there will be a tremendous reheating of the steam when passing through the astern wheel and as this end of the turbine is very cool when going ahead (including the surrounding casing) there are great expansion strains set up as a result of such reheating. Because of this, it is extremely important to pipe saturated steam to the astern element, and this connection must be designed for perfect drainage.

Last Stage Made Double Flow

Blade stresses can be greatly decreased by making the last stage double flow, putting half the total steam through each of two similar short bladed stages instead of all through one long blade stage. This can be done without any complication or sacrifice to offset the gain sought.

It will be noted in the aforesaid brief discussion that there are many factors to be considered in the design of turbines to secure proper results, but to date there have not been many installations made where the design has been carried to its logical degree of perfection. Many very unfair comparisons are being made continually between present-day turbines and the best designed reciprocating engines. It can be very definitely proven, however, that installations can be put into service in which, when unhampered by war speed requirements, quantity production requirements and similar detrimental influences, the turbine driven ship will stand out at all ratings above 1,500 shaft horsepower, as giving the maximum economy for steam propulsion.

Obtaining High Turbine Economy

It is generally considered that the best economy of a turbine driven ship is only obtained by the use of high vacuum, which requires a large condenser, large circulator and a large air pump. These are all very necessary, but the increased economy of the main turbine more than offsets the increased power requirements of these auxiliaries when they are of a proper design. They should be either electric operated or steam engine driven and the driving units should be proportioned to the work they do rather than put in way oversize as is so common. Where the load conditions are as steady and free from peaks as in ship service there is no justification in putting excess capacities in these auxiliaries.

The use of low pressure augmenters is one of the most desirable means of handling the condenser air and non-condensable gases, yet it is just now beginning to be used.

Using Auxiliary Exhaust in Main Turbine

Surplus auxiliary exhaust steam can be very readily used in the main turbine without great complications and is much more efficiently used there than it can be in the low pressure cylinder of a reciprocating engine. The only care necessary is to place a large capacity receiving separator at the low pressure inlet to the turbine to keep the excessive moisture in this low pressure steam from entering the turbine. By the use of a spring-loaded non-return valve the surplus exhaust steam can be automatically controlled.

There is an unreasonable and unjustifiable burden of excessive auxiliaries on our ships today and future development most certainly will be along the lines of fewer units of much sturdier and more dependable design and so interconnected as to make their use more universal. In the examination of actual service records of some 200 ships, it is amazing to find their auxiliaries using up 20 percent of the total fuel while at sea, and 50 to 60 percent of full steaming fuel while in port. When it is noted that they are a non-productive element, this should be considered worthy of far greater attention.

Engine rooms are often fitted with an extra pump here and another there because of imagined requirements and with the thought that they will not affect the economy of operation as they will only be used occasionally. Nothing is more certain than the fact that the average crew will operate a ship as they please and not with the same considerations for economy as the designer contemplated. If there is a big and a little pump available for the same service, the big pump is most apt to be used and it will operate as long a time as the smaller one as it ordinarily will run until such time as it is convenient to stop it. Even if not used, a pump may occasion appreciable thermal losses through condensation and leaky valves as well as through loss by drainage that wastes water.

Electrically Driven Auxiliaries

Electrically driven auxiliaries, with one separate steam driven feed pump, using a non-condensing steam driven generator will always amply provide for the feedwater requirements. By using a turbine driven generator it can be so arranged that steam at 25 to 50 pounds can be extracted from an intermediate stage to heat fuel oil tanks during ordinary requirements instead of wasting thermal units by reducing boiler pressure steam for such service. Some of the better improved and most progressive shipping companies are moving in this direction now and are realizing through experiment that this will be very profitable, as both economy and reliability are obtained.

I think every turbine should be provided with a finely etched flat brass plate upon which the steam flow curves with its different nozzle conditions should be plainly shown. Until such time as an accurate steam flow meter is devised for ship use, this will serve to indicate the most efficient operating condition. Such date must be in this form to be permanently available during a ship's life. It should also include a table of the nozzle dimensions on impulse turbines, or when a velocity stage is used with a reaction element, so that the engineer can check for wear at each inspection. Nozzle plates should be made removable from the outside of the turbine for as yet they all are subject to erosion regardless of the material used.

Accurate and properly piped pressure gages should be provided showing the pressure on the first or inlet nozzles and also the pressure at their outlet so as to keep a check on the nozzle condition or check the steam flow.

Steam Consumption of Turbines

The steam consumption of a turbine may be very easily calculated from pressure readings and nozzle areas. Where the pressure at the exit of the nozzles is below 57 percent of the pressure at the entrance to these nozzles the steam flow may be calculated from either Napier's or Grosstorff's formulas:

Napier's:

$$W_s = \frac{P\text{-}A}{70}$$

Where; W = pounds per second
P = pounds absolute pressure
A = area throat in square inches.

Grosstorff's : $W_s = .0165\ AP^{.97}$

Where; W = pounds per second
P = pounds absolute pressure
A = area throat in square inches.

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Where the exit pressure is above 57 percent of the inlet pressure to the nozzles the steam flow is calculated by the following formula (for nozzles):

$$W_s = \frac{AV}{144\,Sv}$$

W = pounds per second
V = velocity in feet per second
$= 223.6\sqrt{\text{B.T.U.}}$ due to pressure drop
Sv = specific volume of steam at exit pressure
A = area in square inches.

To calculate the flow through a reaction turbine use the following formula:

From Goudie's "Steam Turbines":

$$W = \frac{D^3\,\pi^2\,Z\,N\,\sin\Theta}{60\,P\,V_1}$$

$$W_1 = \frac{\pi\,D\,(L + ac)\,\sin\Theta\,V_o}{144\,v_o}$$

W = pounds per second through the blades
W_1 = pounds per second through the clearance space
D = pitch diameter of blades
L = length blade and tip clearance
C = length tip clearance
Θ = exit angle of blades
V_o = steam velocity
v_o = specific volume of steam at exit
V_1 = specific volume of steam at mid point of first expansion
a = coefficient usually 1.92 (when $\Theta = 20°$)
D_1 = bore of casing = $O.D.$ of clearance space.

It is evident that even when the constants are given there are variables here that can only be calculated by actually going through the design of the turbine. An approximation may really be made by dividing the total British thermal units drop through the turbine by the number of expansions, and this in turn by the number of rows of moving blades of the first expansion. Multiply this by 1.025 to allow for approximate reheat value.

Then: $V_o = 223.6\sqrt{\dfrac{H \times 1.025}{E \times e}}$

H = total British thermal units drop through the turbine
E = number expansions
e = number moving blades first expansion V_o can be obtained directly from the steam tables by noting the pressure resulting from a drop of $\dfrac{H}{E \times e} \times$ B.T.U. below the inlet pressure.

Where there is a compound turbine used the actual energy distribution may be determined by noting the steam pressure and temperature at the inlet and exit of the high pressure turbine. The designed rating of the unit, however, nearly always provides for equal power between the turbines on account of mechanical necessities.

These initial steam pressures given above are the only ones that affect the steam flow. It is often considered that low vacuum affects the flow but the range it has in ordinary operation is such that it never affects the pressure at the first nozzle exits, hence does not affect the flow. Therefore, at low vacuum the same amount of steam is being used, but less power is being developed (see lower curve Fig. 9), which explains the poor economy for this condition.

Efficiency of the Impulse Turbine

The impulse turbine or velocity staged wheel develops its greatest efficiency when the velocity of the steam (in feet per second) is twice the velocity of the blades at their mid-length (pitch line). It is not always possible to design a turbine for this condition, but it shows the desirability of adopting conditions to best possible values in designing a ship. It also shows why the economy drops off at partial load. Power extraction from the steam is less efficient, radiation and condensation losses are greater in proportion to the power developed and windage losses decrease but slightly (unless speed is low), hence all elements combine to decrease the economy under this condition. Using the minimum number of nozzles at which the required power can be obtained will maintain a high first stage efficiency due to increased pressure, and will improve the performance of the other stages because of the higher average quality of the steam.

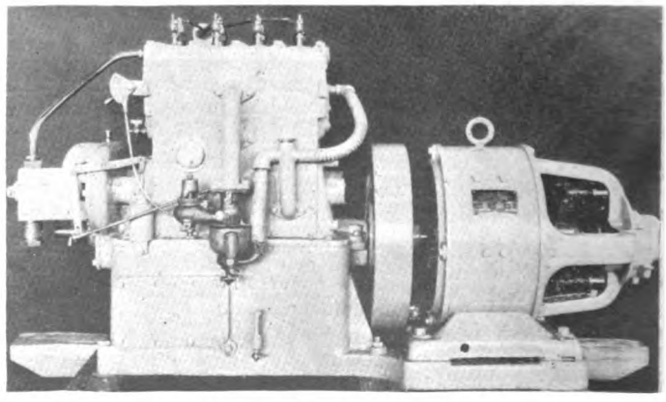
If a turbine is designed to receive a certain amount of exhaust steam at some intermediate stage, it must be carefully proportioned through the remaining stages. The last stages are the most efficient if rightly designed, but if designed for a large pressure drop per stage they will decrease in efficiency when the amount of steam is cut down. This is very often entirely hidden from the operators because of lack of information, and many times the crew will not put surplus exhaust steam in the turbine, but will blow it to the condenser thus incurring a double loss. If the exhaust steam supply is permanently altered because of engine room changes then the nozzling of the main turbine should be recalculated and nozzles from this auxiliary inlet on down should be decreased in number by plugging same to retain the original efficiency as when using the larger quantity of steam.

One more point I wish to emphasize is this. To develop a given power output the steam required is increased 2 percent with each degree of quality. Thus for 98 percent quality, 4 percent more steam will pass through the turbine than if the quality was 100 percent. Therefore the importance of holding a low water level in the boilers to insure as dry steam as possible is evident from the economy standpoint as well as a maintenance standpoint. This can best be accomplished by the installation of the proper automatic feed regulators and is a further reason for adopting these aids to better economy.

New Diesel-Engined Tug Has Successful Trial

THE motor tug *Arthur N. Herron* has recently been completed at the yard of the New York Shipbuilding Corporation for the American Dredging Company of Camden, N. J.

Specially designed for heavy dredge service and very completely equipped, the *Herron* presents a number of in-



Gasoline Engined Stand-by Generating Set

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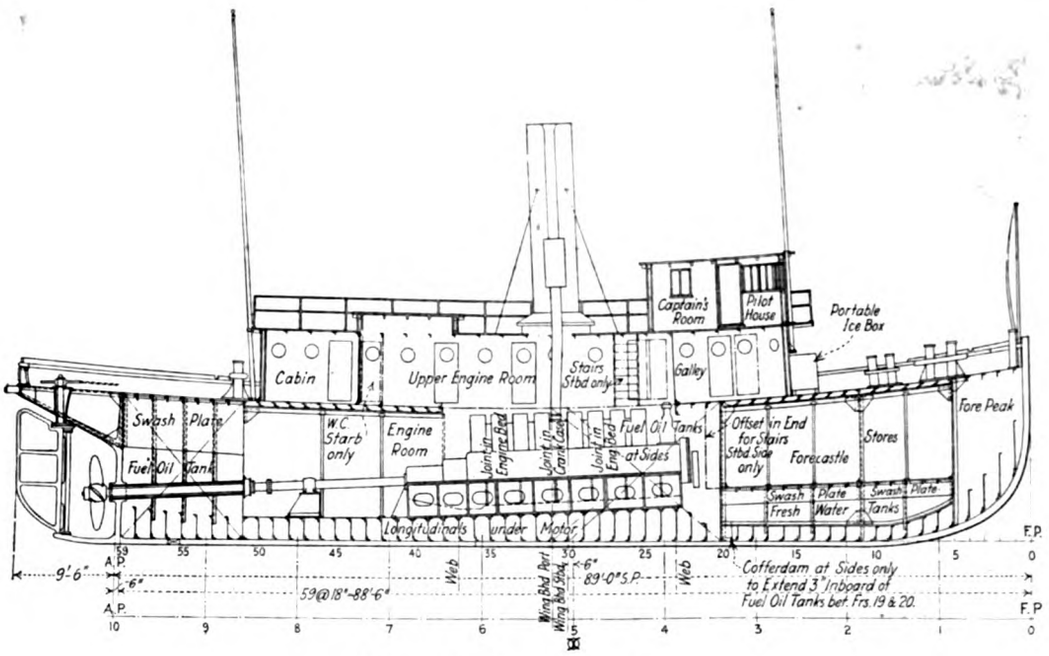


Inboard Profile of Diesel Tug

teresting features, foremost among which is the Diesel propelling machinery.

The general arrangement and construction of the vessel are clearly shown by the accompanying illustrations, the main dimensions and particulars being as follows:

Length overall	99 feet 11 inches
Length to propeller post	89 feet 0 inches
Breadth, molded	23 feet 0 inches
Depth, molded	12 feet 0 inches
Draft, mean, trial	10 feet 2 inches (20-inch trim by stern)
Displacement, trial	312 tons
Deadweight, trial	52 tons
Fuel oil capacity	19,000 gallons
Tonnage, gross	175
Tonnage, net	81

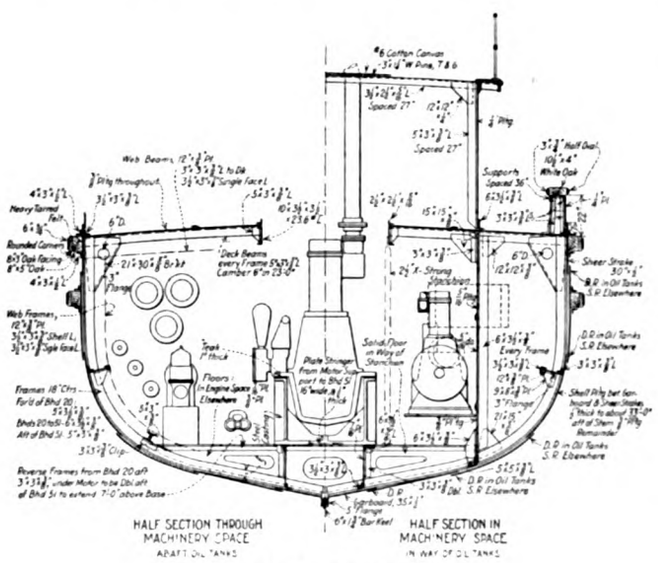
The propelling machinery consists of one Winton-Diesel 4 cycle eight cylinder engine, rated at 500 brake horsepower and directly connected to the propeller. This type of engine, one of the best known of the smaller sized Diesels produced in this country, has been extensively employed in widely varying classes of vessels and has given satisfactory service. Its adoption in a heavy tug of the standard coast type is an engineering development of great interest to shipping people and one, judging from the very satisfactory trial performance, which will be entirely successful.

The main engine is of the standard Winton four cycle Diesel type. It has eight cylinders, 13 inches diameter and 18 inches stroke and is rated at 500 brake horsepower when making 250 revolutions per minute. The indicated horsepower on the trial was 617 at 248 revolutions.

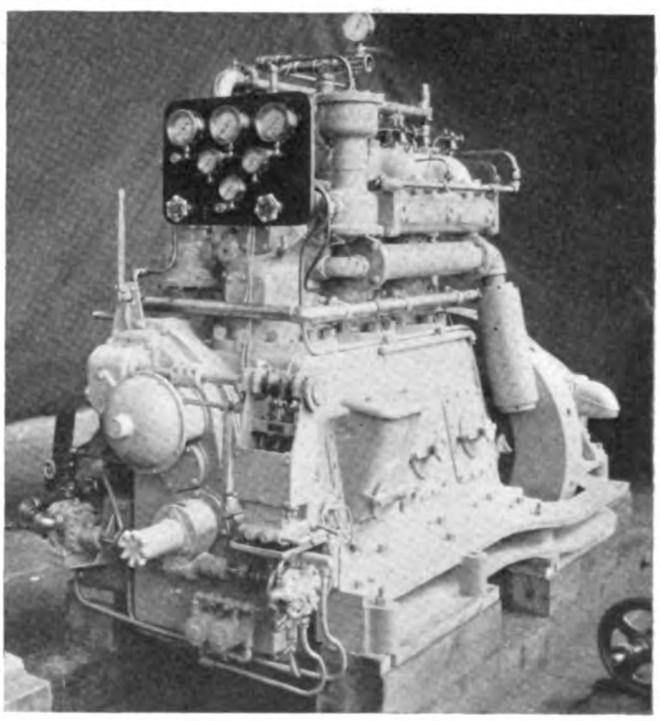
The auxiliaries are all electrically driven, power being furnished by a Winton-Diesel engine, having cylinders 7½ inches diameter by 11 inches stroke driving a Westinghouse generator of 20 kilowatts capacity. The air compressor and the auxiliary generating set are shown in the illustrations.

The trial was run on the Delaware River, between Camden, N. J., and Chester, Pa., on January 30, 1924. The drafts on trial were 9 feet 4 inches forward and 11 feet 0 inches aft, corresponding to a fresh water displacement of 312 tons. The speed of the boat was approximately 10 knots at full power and the engine reversed easily and quickly. The air compressor and storage capacity were apparently quite sufficient to meet the heavy demands for rapid and almost continuous maneuvering which are characteristic of towboat service.

An interesting incident of the trial was a pulling test between the *Herron* and a steam tug owned by the dredging



Midship Section



20-Kilowatt Generating Set

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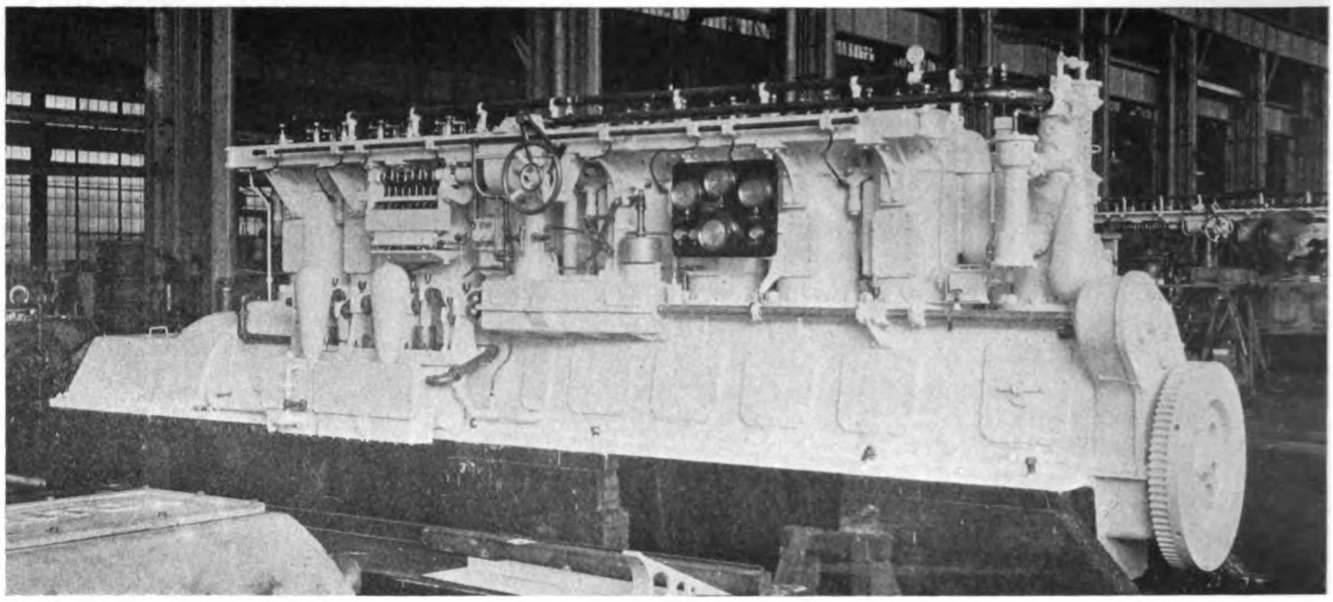
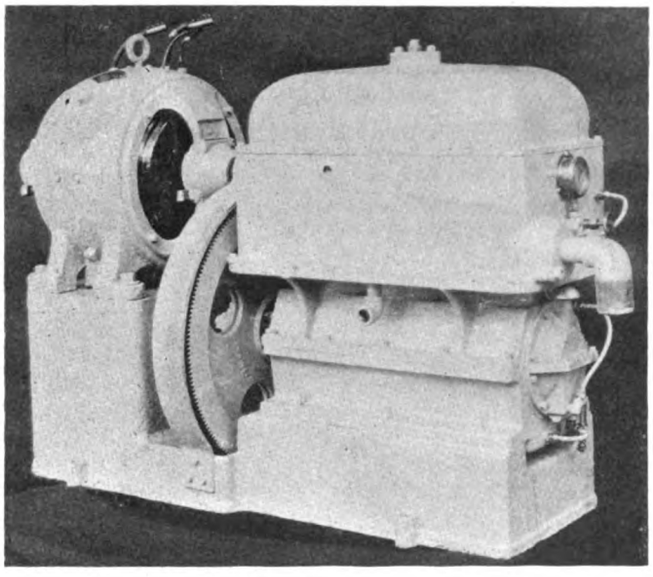


The Main Engine Develops 500 Brake Horsepower at 250 Revolutions per Minute and Weighs 44 Tons

company. The motor tug easily pulled the steam tug stern first against the full power of the latter's engines, but it must be noted that the former was somewhat larger and had considerably greater power than the steam propelled vessel. The test, however, appeared to give considerable satisfaction to the dredging company officials who were present and who were much gratified by the general performance of the vessel.

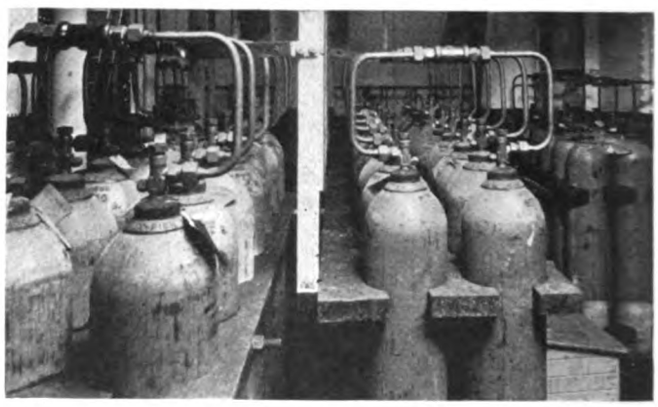


Air Compressor

Lux-Rich Fire Detecting and Extinguishing System Installed on the Motorship Challenger

THE cargo spaces, paint and oil room of the M. S. *Challenger* are protected with the Lux-Rich system of smoke detection and carbon dioxide fire extinguishing. The first product of an incipient fire, namely, smoke, is drawn by the exhaustor of the Rich system to the wheelhouse, where it is brought to the attention of the officer. The first diluted traces of smoke are made strikingly visible by the ingenious arrangement of illumination.

To extinguish the fire the same piping conveying the smoke is used to inject carbon dioxide in its liquefied form. Distributing valves alternating the functions of this piping are located in the forward end of the engine room casing. This distributing manifold is supplied by batteries of steel cylinders charged with liquefied carbon dioxide. The cylinders are nested in a part of the forepeak stores on the upper 'tweendeck. By releasing a proper number of cylinders, the atmosphere within the cargo space on fire is rendered inert and incapable of supporting combustion, and the fire is extinguished without water or steam damage to the ship structure or cargo.



Steel Cylinders, Charged with Liquified Carbon Dioxide, Nested in the Forepeak

The carbon dioxide as used by the Lux system is identical to that used in ice machines and can be purchased at almost any port. The equipment on the *Challenger* consists of seventeen detecting and distributing lines.

THE DEFOE BOAT & MOTOR WORKS, Bay City, Mich., which is now equipped for building steel or wooden vessels up to Welland-canal size, is arranging its plant for building the largest Lake freighters. The company has under construction two 200-foot double track steel car floats for the Erie Railroad for use in Chicago and three large Diesel-driven steel yacht.

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Propelling Machinery of the New Light Cruisers

Machinery Arrangement Details of Ten Light Cruisers Constructed at Todd, Bethlehem and Cramp Yards

By Lieut.-Commander Alex. M. Charlton, U. S. N.

THE ten light cruisers now going into commission in the United States Navy have the most powerful propelling machinery of any class of vessels in the service and aside from the battle cruisers, the most powerful of any vessels heretofore designed for the navy.

Designed for 34.5 knots on a displacement of 7,200 tons, their four shafts develop over 90,000 horsepower at full power. This is three times the horsepower of our latest battleships which displace about 33,000 tons. In other words, while the battleships have about 0.9 horsepower per ton of displacement, the light cruisers have 12.5 horsepower per ton of displacement and about 10 horsepower per square foot of machinery floor space. To get this tremendous power successfully into the small spaces available, speaks highly of the engineering talent responsible for the design and execution of the project.

The contractors for these vessels and the type of machinery installed are as follows:

Omaha, *Milwaukee*, *Cincinnati*	Todd Shipyards Corporation, Westinghouse Electric & Manufacturing Co.
Raleigh, *Detroit*	Bethlehem Shipbuilding Corporation, Fore River, Curtis
Richmond, *Concord*, *Trenton*, *Marblehead*, *Memphis*	Wm. Cramp and Sons Ship and Engine Building Company—Parsons

Because of the radical increase in power demanded and the limited weight allowable for machinery, a scale of bonuses and penalties was incorporated in the contracts for these vessels.

Note 1—These bonuses and penalties applied to full power oil consumption and horsepower and to oil consumption at reduced powers, as well as to total weights of machinery. Although the figures may not be disclosed, it may be said that all three companies earned the bonus for total power developed as well as most of the bonuses for economy in oil consumption.

Necessity for economy at reduced speeds is quite evident from the fact that at 10 knots, but 5 percent and at 20 knots but 14 percent of full power is needed to drive the vessel.

Location of Machinery

On all of the light cruisers the power plant is divided into four units, each unit connected to its own shaft and each one fitted with its own condenser and vacuum apparatus. The turbines for the inboard shafts are placed in the after engine room, and those for the outboard shafts in the forward engine room.

Fig. 1 shows the Westinghouse machinery installed on the *Omaha*, *Milwaukee* and *Cincinnati*. Each unit consists of a high pressure, a low pressure, and a cruising turbine for ahead motion, and an astern turbine fitted in the same rotor casing as the low pressure ahead turbine.

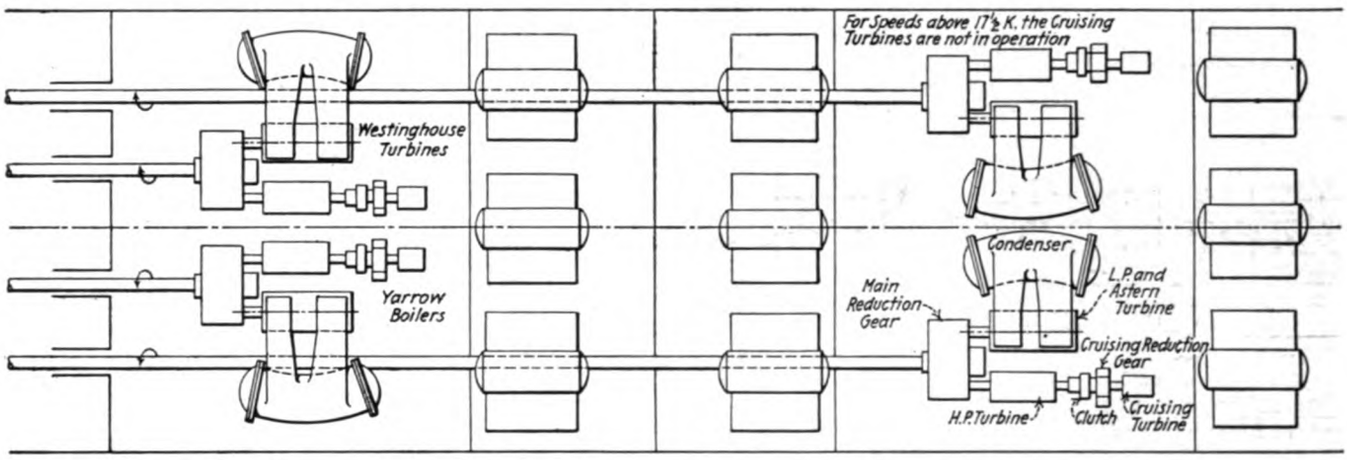

Fig. 1.—Machinery Arrangement of the Omaha, Milwaukee and Cincinnati

The high pressure turbine is made up of an impulse stage consisting of two rows of impulse blading on a wheel, followed by reaction blading mounted on a drum. Steam is admitted to the nozzle blocks of the impulse blading through six hand-controlled valves and after passing through the impulse blading, goes through the reaction blading and exhausts to the low pressure turbine.

A connection is fitted from the cruising turbine to the first rows of the reaction blading. A by-pass valve allows steam to be sent from the impulse blading around the first section of the reaction blading. A connection is also fitted on the turbine casing for the admission of auxiliary exhaust steam to the last group of reaction blading.

The high pressure turbine is connected to the propeller shaft through a single reduction gear of the Westinghouse type, consisting of helical gears with the pinions carried in flexible frames. The speed reduction is 6.815 to 1, the turbine running at a speed of 2,521.84 revolutions per minute for the designed full speed of the shaft of 370 revolutions per minute.

The cruising turbine consists of one row of impulse blading mounted on a wheel. The shaft of this turbine is connected to the shaft of the high pressure turbine through a

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reduction gear and a clutch. The reduction between the cruising turbine shaft and the high pressure turbine shaft is 5.62 to 1.

The cruising turbine is in use for speeds of the vessel up to 17.5 knots (164 revolutions per minute). At this speed of the main shaft the cruising turbine runs at a speed of 6,285 revolutions per minute. Above speeds of 17.5 knots the clutch is disconnected.

Synchronizing Device Installed

A synchronizing device is fitted for indicating the proper time to throw in the clutch. This device consists of gears driven from the two shafts to be connected. These gears in turn, drive the two ends of a differential to which an indicator is connected.

The low pressure turbine is of the double flow reaction type. The steam enters at the center, passes both ways through the blading and exhausts to the condenser. This turbine is geared to the main shaft through pinions which mesh with the same gear driven by the high pressure turbine.

In the same cylinder with the low pressure turbine is the astern turbine. It has two rows of impulse blading mounted on a single wheel. It will develop 30 percent of the ahead full power, and while doing so, will give the vessel a speed of about 20 knots in the astern direction.

The high, the low and the cruising turbines are each fitted with an over-speed governor and valve by which the limiting speeds of the turbines may be adjusted.

The glands of the turbines are of the labyrinth type, steam sealed for starting and maneuvering. Above 700 revolutions per minute of the turbines a water seal is used, automatically cut in by a gland control governor. This seal is obtained by means of a runner on the shaft which produces a centrifugal head, balancing the water pressure admitted from the main feed system at the reduced pressure of 7 pounds.

Reduction Gears on the Omaha

The reduction gears are of the Westinghouse type consisting of double helical gears with the pinions carried in flexible frames. Each reduction gear is enclosed in an oil tight casing and lubricated from the forced lubrication system.

Steam for the turbines is supplied by twelve Yarrow boilers placed in four firerooms. Each boiler has 7,523 square feet of heating surface and supplies steam at 265 pounds pressure. Oil fuel is burned in six burners per boiler. These burners are of the "Lodi" type as manufactured by the Babcock and Wilcox Company. Air for combustion is supplied by twelve Sturtevant turbine driven blowers each of which will supply 50,000 cubic feet per minute against 7 inches static pressure.

The passage of steam through the turbines is as follows: At low and intermediate speeds steam is admitted to the cruising turbine and exhausts to the cruising stage of the high pressure turbine (by-passing the impulse blading).

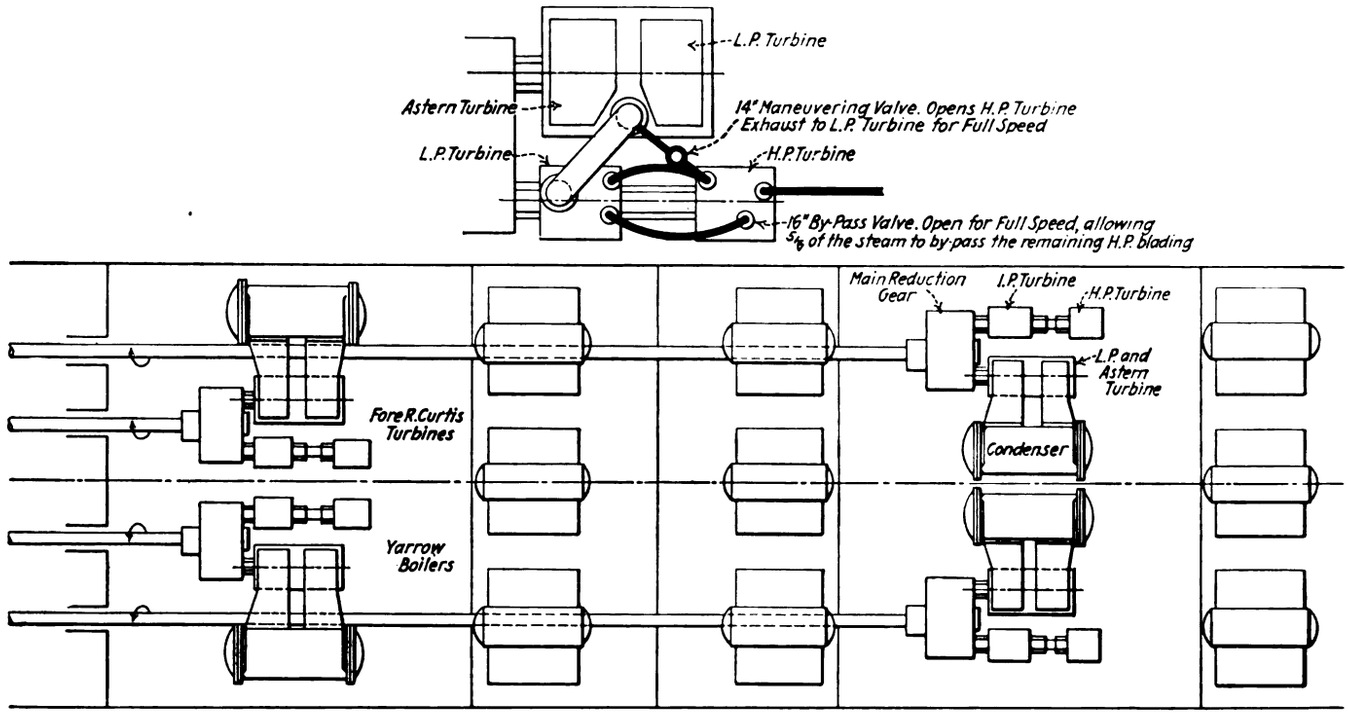
L.P. Turbine
Astern Turbine
14" Maneuvering Valve. Opens H.P. Turbine Exhaust to L.P. Turbine for Full Speed
L.P. Turbine
H.P. Turbine
16" By-Pass Valve. Open for Full Speed, allowing 5/6 of the steam to by-pass the remaining H.P. blading
Main Reduction Gear
I.P. Turbine
H.P. Turbine
L.P. and Astern Turbine
Condenser
Fore R. Curtis Turbines
Yarrow Boilers

Fig. 2.—Machinery Arrangement of the Detroit and Raleigh

After going through the high pressure turbine, the steam exhausts to the low pressure turbine. At 17.5 knots the cruising turbine is disconnected. Steam is then admitted to the high pressure turbine, passing through the impulse and reaction blading to the low pressure turbine. At 30 knots a by-pass valve on the high pressure turbine is opened. This allows the steam, after it passes through the impulse blading, to by-pass the first part of the reaction blading. These conditions hold up to full power.

The surface condensers fitted on these vessels are cooled by "scoop" injection, following destroyer practice, no circulating pump being necessary at speeds above 7 or 8 knots. A circulating pump is furnished to supply cooling water for backing and for low speeds.

The vacuum apparatus consists of turbine driven condensate pumps together with Westinghouse-Leblanc air ejectors designed for 28 inches vacuum at full power.

Arrangement of Machinery for Raleigh Type

The arrangement of turbines for the *Detroit* and the *Raleigh* is shown in Fig. 2. The turbine equipment on these vessels consists of a high pressure, an intermediate pressure and a low pressure turbine geared to each shaft. An astern turbine is fitted in the casing of each low pressure turbine.

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The high pressure turbine consists of eleven Curtis stages, the first stage having two rows of blades. From the high pressure turbine the steam exhausts to the intermediate pressure turbine the shaft of which is coupled to the high pressure shaft through a flexible coupling. The intermediate pressure turbine has seven Curtis stages. From the intermediate pressure turbine, steam exhausts to the center of the low pressure turbine which is double flow. After passing through five Curtis stages at each end of the low pressure turbine the steam exhausts to the condenser. The astern turbine is in the same casing with the low pressure turbine. It has two Curtis stages, each with two rows of blades. These turbines are designed to develop sufficient power to drive the vessel astern at a speed of 20 knots. The turbine glands are of the labyrinth type, steam sealed.

The arrangements for various speeds are as follows:

At 10 knots and below, steam is admitted into the high pressure turbine through a special nozzle piped direct from the main steam lines. Branches from the auxiliary exhaust line connect to the second stage of each high pressure turbine.

At cruising speeds, steam is admitted to the steam chest of the high pressure turbine where it passes through the three turbines to the condenser.

At full speed, steam is admitted to the high pressure turbine. After expanding in the first stage, one sixth of the steam will pass through the high pressure turbine, while five-sixths is passed to the steam chest of the intermediate turbine. Steam from the high pressure and intermediate pressure turbines unite and pass to the low pressure turbine and thence to the condenser.

The turbines all run at a speed of about 2,500 revolutions per minute at full speed. The reduction is 6.28 to 1 for a propeller speed of 400 revolutions per minute.

Gearing for High and Intermediate Stages

The gears on the high pressure and intermediate pressure shaft and those on the low pressure shaft are of the same size, two helicas on each side meshing with the gear on the propeller shaft. The reduction gears were manufactured by the Falk Company, the gears being of cast steel and the pinions of forged steel. A novel feature of these pinions is the cutting of an annular slot ten inches deep in each end of the 24-inch helix. This slot is packed with asbestos fiber and the ends sealed with snug fitting 1-inch steel rings. This undercutting of the pinions materially reduces vibration and noise, particularly the high-pitched notes. This method of construction also eliminates variation of tooth pressure along the length of the pinion by insuring that the torque is applied nearly at the center of each half pinion.

Steam Supplied by Yarrow Boilers

Steam for the turbines is supplied by twelve Yarrow boilers each with 7,507 square feet of heating surface, placed in four boiler rooms. The forced draft blowers and the fuel oil burners are similar to those installed on the *Omaha*. The vacuum apparatus on the *Raleigh* and *Detroit* is also similar to that on the *Omaha*, Westinghouse condensate pumps and air ejectors being employed to produce 28 inches of vacuum at full power.

Cruisers at Cramp Yard

The arrangement of turbines in the vessels built and building by William Cramp and Sons, the *Richmond, Concord, Trenton, Marblehead* and *Memphis*, is shown in Fig. 3.

This arrangement shows four main propelling units, each consisting of a high pressure and a low pressure turbine of the Parsons type each in a separate casing, the two turbines driving the propeller shaft through reduction gearing. An astern turbine consisting of two Cramp impulse stages is fitted in each low pressure casing.

A cruising turbine of the Cramp impulse type with a hydraulic clutch and reduction gear is fitted to the forward end of the high pressure rotor shaft on number 1 and number 3 main shafts.

The high pressure turbine has ten expansions carried out in a total of 56 rows of blades. Inlets are provided for admitting cruising steam to the first and third expansions, main steam at the fifth and auxiliary exhaust at the seventh expansion. The low pressure turbine takes the exhaust from the main turbine and carries out the expansion both ways from the center through eleven expansions with a total of seventeen rows of blades. The steam then exhausts to the condenser. The low pressure and high pressure turbine shafts are connected to their respective pinions shafts by flexible couplings. The cruising turbine has two impulse stages, each stage of which is fitted with two rows of blades on one wheel.

The main reduction gears are helical, the gears having a center of cast steel and a rim of forged steel, while the pinions are of forged steel. The high pressure pinion has a pitch diameter of 12.726 inches, the low pressure pinion a pitch diameter of 21.556 inches and the main gear a pitch diameter of 7 feet, 3.005 inches. For the full propeller speed of 368 revolutions per minute, the high pressure tur-

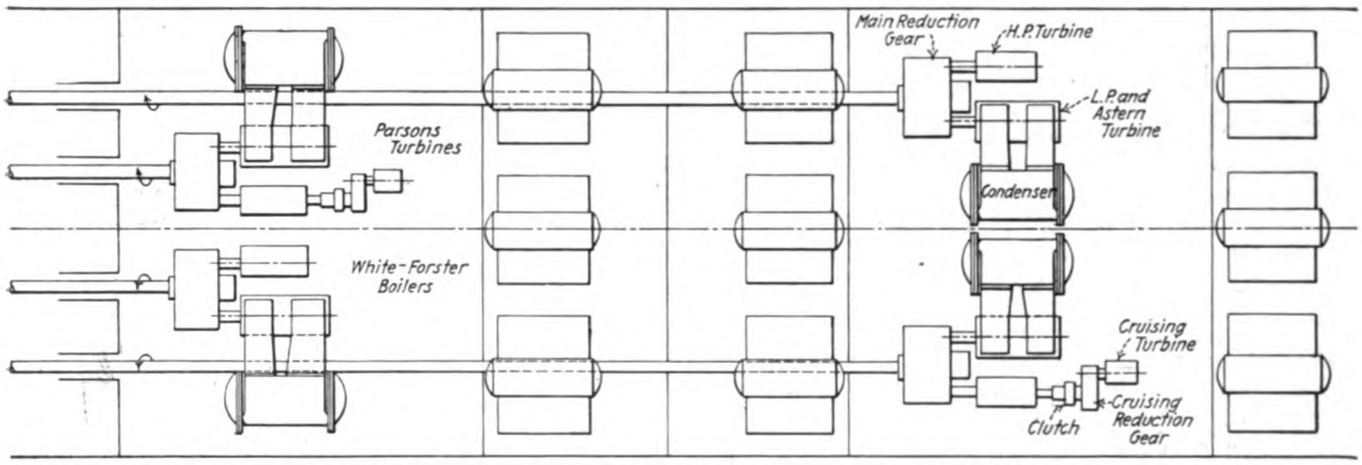

Fig. 3.—Machinery Arrangement of the Richmond, Concord, Trenton, Marblehead and Memphis

For speeds up to 16 knots the cruising turbines exhaust to the high pressure turbine connected to the opposite shaft in the same compartment; for speeds between 16 and 20 knots they exhaust into both high pressure turbines in the same compartment; for speeds above 20 knots the cruising turbines are not in operation.

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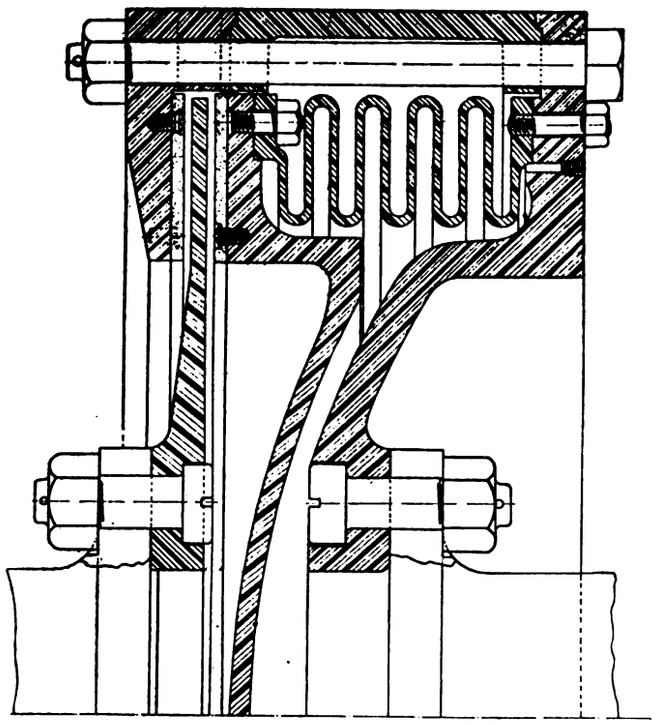

Fig. 4.—Half-Section of Metten Hydraulic Clutch

bine runs at 2,515.9 revolutions per minute and the low pressure turbine runs at 1,485.3 revolutions per minute.

Cruising Gears of Helical Type

The cruising reduction gear consists of helical gears of which both gears and pinions are of forged steel. The pitch diameter of the gear is 21 inches, while that of the pinion is 6.6 inches, giving a reduction of 3.18 to 1. For a speed of 20 knots which is the upper limit of the cruising turbine, the latter runs at 4,050 revolutions per minute. The gears are of De Laval manufacture.

The cruising turbines are disconnected from the main high pressure turbines by means of a hydraulic clutch known as the Metten clutch (Fig. 4). Oil for operating this clutch is supplied through the hollow shaft of the cruising reduction gear, by means of a small gear pump driven from the cruising gear shaft. The friction surfaces are made of thermoid brake lining.

A balanced piston valve hydraulically controlled by the clutch oil pressure is placed in the steam line to the cruising turbines and so arranged that in case of failure of the clutch oil pressure, thereby releasing the clutch, it will close and prevent overspeeding of the cruising turbine.

Gland steam is supplied from the auxiliary exhaust line and controlled by a dead weight reducing valve adjusted to maintain about one pound pressure in the gland pockets.

Eliminating Gland Leakage

An interesting device for saving leakage from the glands has been installed in the Cramp vessels. The leak-off from the glands is collected by means of a small exhaust fan, condensed, and the condensate returned to the reserve feed tanks by gravity. Besides saving 600 to 800 gallons of fresh water per 24 hours, the humidity and temperature of the engine room air are much reduced.

The path of steam through the turbines is as follows: For speeds up to 16 knots, steam is admitted to the cruising turbine in each compartment. From the cruising turbine steam goes to the high pressure turbine on the opposite side of the ship and passes through the high and low pressure turbines on that side. The high pressure and low pressure

Vessel	Speed in knots	Horse power	Lbs. oil per knot	Water rate per s.h.p. main engines	Remarks
	Full power				
Omaha	34.87	94,860	2,746	13.41	
Detroit	34.63	97,370	2,637	11.38	
Richmond	34.20	92,772	2,547	not taken	
	30 knots				
Omaha	30.01	46,800	1,392	13.34	
Detroit	30.09	48,813	1,438	13.19	
Richmond	30.04	50,535	1,428	not taken	
	15 knots				
Omaha	15.07	4,500	564	27.12	Cruising turbines
Detroit	15.20	4,726	476	19.92	
Richmond	15.04	4,635	398	not taken	Cruising turbines

units to which the cruising turbine is connected, revolve idle in a vacuum.

For speeds up to 20 knots, steam is admitted to the cruising turbine and exhausts to both high pressure turbines in the compartment, going through both high and low pressure turbines to the condensers.

Above 20 knots the cruising turbines are disconnected and steam is admitted into one or the other of the cruising stages of the main turbines, depending on the speed, exhausting thence to the low pressure turbine.

At full speed steam is admitted to the steam duct of the high pressure turbines and expanded into the low pressure turbines. Steam for the turbines is supplied by twelve White-Forster boilers. Each boiler is fitted with fourteen fuel oil burners of the Bureau of Engineering design. The forced draft blowers are similar to those installed on the *Omaha* and *Detroit*. On these Cramp vessels a main air pump is fitted, working in conjunction with a Radojet vacuum augmenter and an augmenter condenser.

Five of these ten light cruisers are in commission and have made extended shakedown cruises. They have proved

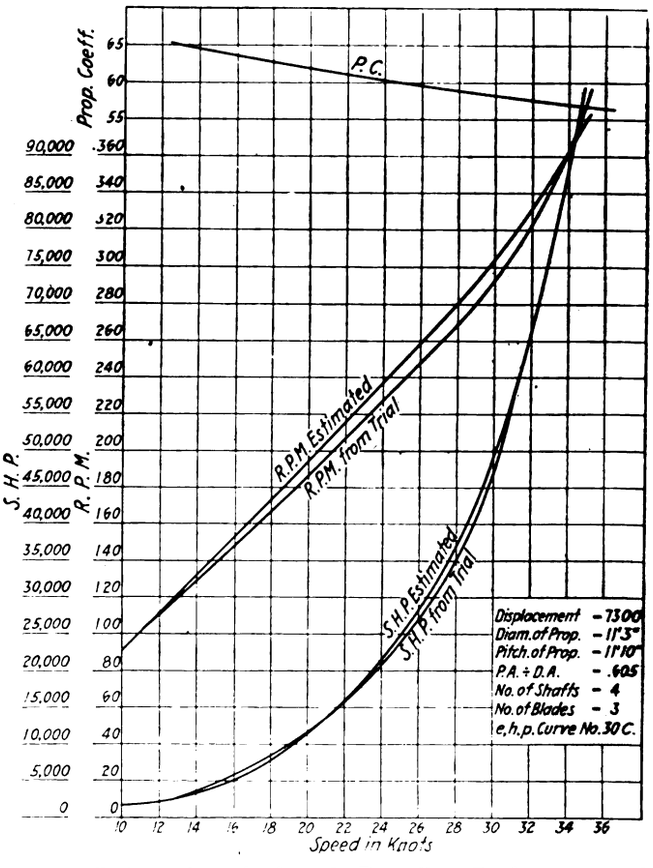

Fig. 5.—Estimated and Actual Propeller Performance of U. S. S. Detroit

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themselves to be excellent sea boats with reliable and economical machinery.

DESIGN OF PROPELLERS

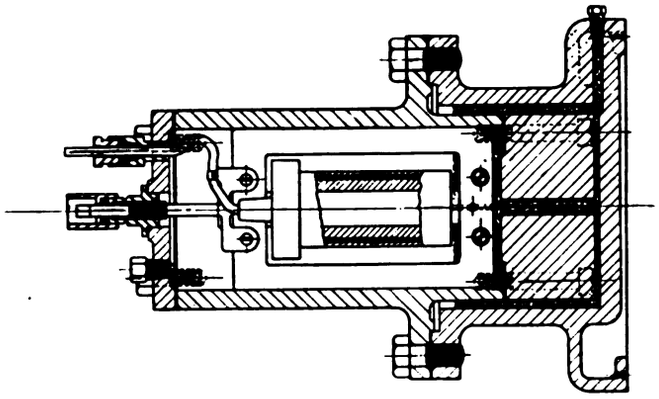
In designing the propellers for these vessels and in computing the shaft horsepower necessary to drive the vessels at the required speed, the method developed by Rear-Admiral C. W. Dyson, U. S. N., was used. In this method the effective horsepower as found from model tank experiments, together with the dimensions and form of the vessel are used to enter a number of curves. By this method cavitation of the screws is avoided and an estimate of revolutions per minute and shaft horsepower at various speeds is obtained which is remarkably close to the actual trial data. The curve (Fig. 5) shows the estimated and trial results on the U. S. S. *Detroit*.

The tables give a comparison of the various vessels as to horsepower, oil consumption and water rates at various speeds.

Measuring the Flow of Steam in Pipes

AN electrically operated flow meter which has recently been placed on the market by the General Electric Company, Schenectady, N. Y., was designed to provide a means for the accurate measurement of the total flow of steam, water, air, gas, oil, etc., through pipes. Due to the electrical principle of operation, the indicating, curve-drawing and integrating instruments can be located any distance away from the pipe where the flow is being metered. Instruments can be either separated, grouped or arranged as requirements dictate.

The meter consists of three principal elements: The differential pressure producing device, the cast iron meter body piped to the differential pressure producing device and the electrical measuring instruments mounted on the panel. The cast iron meter body is constructed in the form of a U-tube. Within one leg of this tube is a coil through which the current flows in its path through the meter body and back to the



Sectional View of Body of Electrically Operated Flow Meter

panel. As the differential pressure increases, mercury is forced up around this coil, acting as a secondary inducing more current in the primary. This increase in current is indicated on the electric instruments and, as the differential pressure bears a definite relation to the flow, the current shown on the instruments will likewise bear a definite relation to the flow.

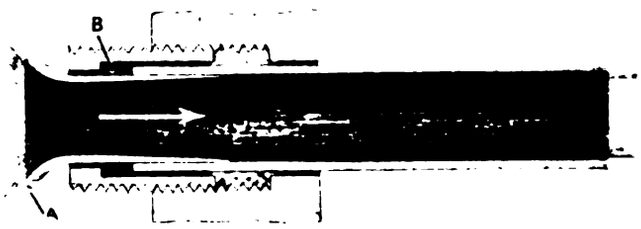
On the outside of the meter body a small transformer is mounted whose function is to reduce the voltage applied to the internal transformer in the meter body as well as to act as an insulating transformer. In series with the primary of this transformer are the adjustable line resistance, voltage regulator resistance and electrical measuring instruments.

When there is no flow of gas or fluid through the main pipe, the electrical instruments indicate the excitation current and the zero readings on the instruments and meters are suppressed so that zero flow corresponds to this excitation current. When the gas or fluid flows through the pipe there is a differential pressure produced by the flow nozzle, causing the mercury in the meter body to rise in the transformer leg and fall in the base until the unbalanced column balances the differential pressure. By proper calibration, the electrical instruments will accurately measure the height of mercury in the small leg of the U-tube containing the internal transformer, which height is a function of the flow of gas or fluid in the pipe.

Condenser Tube Entrance Nozzle

AUXILIARY brass shields or tubes designed for insertion in the entrance end of condenser tubes to eliminate causes leading to corrosion have been developed by Albert E. Mace & Company, Boston, Mass., under the name of "Flowrites."

It is generally conceded that the entrained and dissolved air in the circulating water is responsible for much of the



"Flowrites" Shield Installed in a Condenser Tube

corrosion action on tubes and their life depends to a great extent on the characteristics of the water used. The "Flowrites" nozzle *A* shown in the illustration has been designed to eliminate the gas pocket condition which is formed inside the tube entrance at *B*. The nozzle when it is placed in the tube, as shown, prevents the contraction of the jet of water as it enters the tube and tends to stop the liberation of oxygen at that point. The peculiar construction of the nozzle creates a venturi action, materially increasing the flow of water without an additional expenditure of power.

"Flowrites" are made in sizes to fit standard diameter tubes and, when in position, form a practically continuous inside wall and provide a smooth entrance to the tube.

Navigation Law Changes

MARINE underwriters are naturally greatly interested in the revision of United States navigation laws now in progress under a special committee selected by the American Steamship Owners' Association. Insurers hope the work will result in stimulating American shipping and make it easier for this country to compete in the markets of the world. With more American ships on the seas, it may logically be assumed that there would be more of a market for American marine insurance. In general, American underwriters are satisfied with the manner in which American shipping is operated at present. During the war a large proportion of American seamen were incompetent, the owners being unable at that time to secure the class of help they wanted; but by now most of the incompetents have been weeded out. The American underwriter feels that he has done his utmost to meet his share of the obligation and is justified in pointing out that American insurance companies have a maximum of financial solidity behind them and are ready to offer sound protection to American shipping interests.

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Winter Hazards Affect Insurance Rates

Conditions in Mexico and Japan—Lake Hulls—Perils at Halifax and Baltic Ports—Ships' Lives Insured

By "Bordereaux"

So far as Mexico is concerned, marine underwriters feel that most, but not all, of their troubles are at an end. The capture of Vera Cruz by the federal forces indicates upon which side victory is to incline. However, although war rates are returning to normal, the theft and pilferage hazard calls for an increase of attention. After such a disturbance as Mexico has been passing through, with people sustaining continuous hardships and police protection even less efficient than usual, it is to be expected that watchman service will relax to a point of danger. Underwriters are in somewhat of a quandary as to their position with respect to the heavy movement of goods to Vera Cruz prior to the taking of that city by the rebels. A manifesto, it will be recalled, was issued by de la Huerta to the effect that unless the customs were cleared within a stated time all merchandise would be sold at public auction. It is now regarded as highly probable that the underwriters will have a heavy bill to settle after the last rumble of war has died away.

Congestion at Yokohama

LATE advices to marine insurance companies indicate that just as the underwriters were beginning to feel that the outlook at Yokohama was brightening the actual situation is less encouraging than was believed. It appears that the harbor is so congested that many vessels are unloading into lighters outside the breakwater. This increase in craft-risk is resulting in an additional premium charge by underwriters of ⅛ percent.

The work of remedying conditions at that port is progressing very slowly, and this fact is being carefully weighed by those insurers who are writing goods destined for Yokohama. Although considerable headway has been made in the reconstruction of the godowns, or warehouses, it is, to a large extent, of a temporary character and in no way comparable with the substantial coverings in use before the earthquake. There has been some dredging going on in the fairway which is blocked with sunken and burnt lighters and the steamship companies are busily engaged in clearing the way in front of their quays. Several of them have extended long wooden piers to make the lighters more accessible. The capacity to care for incoming goods is gradually increasing and as the consignees are generally anxious to get their merchandise away and the customs formalities have been greatly simplified, it would seem as though there should soon be but little cargo lying in the sheds. Underwriters are not overlooking the risks of lighterage, the many new obstructions and the lack of facilities for the making of adequate repairs.

Forrest E. Single, representative in Japan of American marine underwriters, has written his New York clients listing several bad conditions at Tokio and Yokohama. There is enough congestion of shipping at the present time to force vessels to wait several days for an opportunity to discharge. Furthermore, the want of an adequate number of warehouses has created a serious exposure hazard which is the more threatening because of the approach of the annual rainy season. Many thousands of dollars' worth of goods are lying unprotected along the waterfront. Falling markets, entailing financial problems, have led to the abandonment of shipments. Rather than meet their obligations with a shortage of funds a number of Japanese importers are failing to claim goods consigned to them, leaving them in customs in peril of fire, water damage and pilferage.

The fire hazards have been increased at Tokio and Yokohama because of the disruption of water mains, and there is a serious possibility of floods on account of the sinking of breakwaters and other means of protection along the fronts.

Lake Hull Underwriting

IT might be concluded from a superficial consideration of the recent report of the Lake Carriers' Association that underwriters of lake vessels had a highly successful season. According to this report the season was a record-breaker in volume of freight tonnage moved, absence of winter storms preceding the season's close and tonnage enrolled in the association. It further states that not in twenty-one years have the lakes been so free of devastating gales as in 1923. The largest volume of shipments ever known in that region were made in coal, grain and iron ore.

But for the other side of the picture. Underwriters are only too well aware that even in these good seasons lake vessels have the bad habit of grounding and colliding, which run up heavy bills against the insurers. Moreover, a study of statistics covering a length of time indicates that where one season shows a noticeable absence of casualties the next season usually reveals an excess of them; the loss ratio appears to remain about the same.

Wooden Oil Boat Explodes

THE explosion of the wooden oil boat *Bang* in the East River, New York, has entailed not only a total loss but a formidable series of problems for underwriters. As to the hull, the explosion risk is, of course, covered under the perils clause of the standard hull policy, but with respect to the cargo, unless the explosion clause, "including loss, damage or expense resulting from explosion," had been added to the usual form the assured would have no claim unless the explosion were the proximate cause of the fire. The facts here are peculiar in that it was thought by observers that the oil was ignited by sparks from a fire built by the crew as relief from the intense cold. If this theory is proven to be correct the underwriters are unquestionably liable for the loss on the ground that fire, which is a peril insured against, was the proximate cause of the disaster.

Underwriters Lose Collision Suit

THE New York Supreme Court recently decided an interesting controversy that grew out of conditions existent during the World War and which centered in the mishap that befell the steamer *Napoli*. This vessel sailed from New York in the summer of 1918 with a cargo consisting largely of war material, and while proceeding in the Mediterranean in convoy and without lights was sunk as a result of a collision with another vessel similarly convoyed. The marine and war risks were insured with two different insurance companies and the insurers of the former endeavored to escape liability by showing that the loss was directly attributable to the manner in which the vessel was proceeding and the nature of her cargo (contraband); in

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other words, that she was pursuing warlike operations, loss resulting from which was specifically excepted under the marine policy.

But the court followed opinions laid down in many previous cases, to the effect that such contracts cannot be construed in a broad sense by contemplating the more remote causes, but that the only cause to be considered was the one nearest the loss. In this case, the collision being the direct cause, the loss fell on the underwriters.

Use of New Russian Port

THERE is but little cargo moving from this country to Russia, and yet it is important to note the attempt to popularize the use of the new Russian port of Murmansk, which was built during the war at the northeastern end of the Pola Peninsula. At this season of the year the ice hazard is particularly bad in that remote region, but by using numerous ice-breaking devices the port was kept open this year until late in January. Several large cotton shipments have been allocated for Murmansk as soon as ice conditions are favorable. As underwriters have had little experience in the use of this port there is some difficulty in arriving at a basis rate and, until further particulars are available, a rate of 3 percent seems to be justified. The main lines of the Russian railways are reported to be in fair condition, although there is a general shortage of cars. Warehouses are also said to be in comparatively good condition and are heavily guarded by the military. Although diplomatic relations have not been renewed by the United States with Russia, merchants are free to trade at their own risk.

Baltic Ice Hazards

NAVIGATION in the Baltic has been seriously hampered of late because of the great quantity of ice in that region. Reports received by underwriters indicate that the ports of Malmo, Landscrona and others along the Sound have so much ice in the fairway and harbors that progress is only possible by the use of tugs. Ice breakers are constantly busy endeavoring to keep open water, and several steamers have already been caught and are held fast in the ice. Still another peril arises from the circumstance that all lightships and lightbuoys in the region are now taken in and the beacons cannot be depended upon to be in their proper places.

Differentials in most tariffs between summer and winter rates change on or about September 15 and March 15, due to longer nights and these ice conditions during the winter months. It is of interest to note, as regards the freezing up of a vessel, that such a situation apparently falls under one of the "excuses for delay provisions" of the Marine Insurance Act of Great Britain—i. e., caused by circumstances beyond the control of the master and his employer—and so deprives the underwriter of any additional premium, even though the vessel be held there for several months.

Underwriters Win "Ionna" Case

THERE is much jubilation among British marine insurers over the final outcome of the famous *Ionna* case, the House of Lords having sustained their contention that the mortgagees interested in the scuttled steamer are without legal right to recover from the underwriters. While this is an important victory it is not as complete as the insurance people desired, in that it still leaves undecided the vital issue as to whether the deliberate scuttling of a ship is a peril covered by the marine policy and that innocent mortgagees may not recover under such circumstances, no matter what their status as assured may be.

Reference has frequently been made to this case in this paper. It will be remembered by our readers that the King's Bench Division held that the vessel had been deliberately cast away and that, despite the fact that the owners could not recover the insurance, still the innocent mortgagees could. The precedent frequently cited at the trial was the "Small" case. The case was carried up to the Court of Appeal and the decision regarding the mortgagees was reversed. The court held that they did not have a separate interest in the policies, but only a derivative one. This position has now been confirmed.

Syndicates Cover Disbursements

THE writing of disbursements insurance has been undertaken by the American Marine Insurance Syndicates. Subscribers to Syndicate "C" have for some time been of the opinion that this coverage ran parallel with hull writings and that it ought to be taken up. An amendment of the articles of agreement was made to this effect last November. The coverage as now being written by Syndicate "C" is of disbursements and/or other total loss interests, the limit remaining, as before, $2,500,000 upon a single hull and/or disbursements. There is a great probability that Syndicate "B" will also write this class later on.

Insures Lives of Ships

A PLAN is afoot in Germany for the introduction into the United States of insurance of the lives of vessels, houses and automobiles. A company has been established by the Deutsche Aufbau, of Berlin, in conjunction with a foreign banking group managed by the Morgan Livermore Company, for this purpose. This class of coverage has been written in Germany since 1921. But there is some doubt of its being permitted in the United States in view of the fact that the system is entirely different from any plan in operation here. In insuring the lives of ships the company follows much the same plan as in its coverage of the lives of houses, to-wit: It issues a term contract on a dwelling, for, say, fifty or more years, during which period it binds itself to keep the structure in repair as regards damage or deterioration occasioned by time and ordinary wear and tear. At the conclusion of the term of the policy the company agrees to pay the full face of the contract, or the sum for which the building was insured irrespective of the condition of the property.

Perils at Halifax Harbor

UNDERWRITERS have frequently been criticised for charging an additional premium on vessels coming from Europe via the port of Halifax, but recent developments go far toward justifying their judgment. The insurance charge for this deviation is usually from 5 cents to 10 cents, depending upon the type of cargo and the individual opinion of the underwriters. A short time ago the steamer *Scythian*, bound for Boston and New York from London, was damaged by striking a rock at the entrance of Halifax harbor. The approach to this port is well known to be infested with dangerous rocks, and the heavy fogs of that region, resulting from the union of the frigid Arctic winds with the milder temperature from the Gulf Stream, render navigation difficult for even the most experienced of masters. Such perils properly call for a proportionate increase in the rate.

New Rates for New Routes

WHEN a vessel is taken off its accustomed route and started on a new trade in a foreign clime, the underwriters are careful to estimate the hazards which it will encounter in its altered environment. A case in point is the steamer *Arna*, a 2,400-ton freighter built for the local Mediterranean trade, which has been chartered to trade be-

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tween New York and Guayaquil via the Panama Canal. The *Arna* took twenty-seven and one-half days to come across from Hull, in twenty-four of which there were successions of gales, snowstorms, squalls and giant seas that towered over the small freighter as she labored in the trough of the waves. On her new route to South America the vessel will have an easier time of it, but nevertheless the stresses and strains will be much different from those to which she has been accustomed or which were contemplated by her builders. Besides which, there will be a wide diversity in the character of the cargo she will hereafter carry. Factors of this nature require considerable adjustment at the hands of insurers.

Great Lakes Shipping Sets New Records

(*Continued from page* 138)

in a single year. The new fleet included bulk freighters of the most modern type, a self-unloading stone carrier that is the last word in ship practice of that type, a self-unloading cement carrier, two different types of motorships for lake and coastwise service, an array of new ships of Welland canal size for the grain and coal trades and a large return of former Lake steamers from the sea trade, several of which had to be brought back in two sections. The 70 additions totaled 98,668 gross tons and, for a single trip, their carrying capacity amounts to 154,750 gross tons, which materially increases the Lake fleet as a whole.

The total vessel losses in 1923 numbered 10 and involved 14,799 gross tons of cargo tonnage. In the destruction of these boats no lives were lost.

Vessel Sales of the Year

In seasons of heavy commerce on the Great Lakes vessel sales run high and 1923 did not prove an exception to the rule notwithstanding that the Lake fleet was extensively augmented by new construction. During the year 88 vessels of all classes changed hands and some of them twice. The amount of tonnage involved amounted to 167,222 gross registered tons. Of the ships sold in 1923, thirty-eight were bulk freighters totaling 112,030 gross tons. The increasing passenger trade on the Great Lakes is reflected in the purchase of four passenger steamers during the year.

Bulk Freighters and the Lake Trade

When the carrying capacity of the Lake fleet was tremendously increased in 1922 by the addition of 19 American and 37 Canadian ships, it seemed at that time as if sufficient vessel capacity had been provided to handle the iron ore, coal and grain traffic for some time to come. This record capacity of the fleet, however, was not long sustained for in 1923 additions of 60 steel steamers for the ore, coal, grain and stone movements were made to the fleet. These are additions that were made only to the fleet of bulk freighters, vessels for package freight or special trades not being included.

Additions to the American fleet consisted of 15 steamers with a combined carrying capacity of 109,750 gross tons while additions to the Canadian fleet amounted to 45 vessels, all but three being of Welland canal type, their combined carrying capacity totaling 125,800 gross tons. Of these vessels 10 were built in Lake yards in 1923, twenty-five were built in the British Isles in 1923 and 25 were already in service and bought for the Lake trade.

With the exception of the steel steamers *Edward U. Demmer* and *Huronton*, which were sunk in collision, the losses in 1923 were inconsequential. Deducting the losses and their capacity, the net gain in bulk freighters for the year totaled 51 steamers of 213,050 gross tons in capacity. On January 1, 1923, the Lake fleet comprised 686 vessels of 3,979,210 gross tons while on January 1, 1924, it comprised 737 vessels of 4,192,260 gross tons.

Building of Bulk Freighters

During the season of 1923, shipyards on the Great Lakes completed 10 new steel bulk freighters that increased the tonnage of the Lake fleet by 63,297 gross registered tons. This additional tonnage has added a carrying capacity of 93,800 gross tons for a single trip to the fleet that is exclusively engaged in the iron ore, coal, grain and stone trades and, assuming that 25 trips constitute a navigation season, has increased the seasonal capacity to 2,345,000 gross tons. Although this is an exceptionally large amount of freight tonnage to be turned out in Lake yards, the year ended with another steamer of 8,000 gross tons practically completed and with three steamers 612 feet long and of more than 8,000 gross tons each contracted for to come out in 1924 besides several others in contemplation.

New construction in 1923 included six steamers 600 feet in length with a beam of 60 feet and depth of 32 feet which is generally accepted in Lake practice as the most efficient type of ore and coal carrier and with the completion of these the total of bulk freighters 600 feet or more long now numbers 54, all of which are in commission. It is of further interest to point out that since the after-the-war resumption of shipping on the Great Lakes in 1920 there have been built not less than 20 bulk freighters of 130,312 gross registered tons. The 600-foot carriers *Worrell Clarkson*, built for the Kinsman Transit Company, and the *Joshua A. Hatfield* and *Richard V. Lindabury*, built for the Pittsburgh Steamship Company, were finished before the opening of navigation, hence each had a full season in the Lake trade. The steamers *W. H. Warner*, built for G. A. Tomlinson, the *Frontenac*, built for the Cleveland Cliffs Steamship Company, and the *Charles M. Schwab*, built for the Interlake Steamship Company, were completed and commissioned by mid-season.

New Self-Unloaders

To provide adequate capacity for the increasingly large stone trade, the *B. H. Taylor*, a self-conveyor 550 feet long and of 10,500 gross tons capacity, was built for the Michigan Limestone and Chemical Company. This vessel is a sister ship of the *W. F. White* and *Carl D. Bradley* and contains some additional unloading facilities as experience has shown desirable. She makes the ninth self-unloader that has been turned out at Lake yards for the particular trade in which she is engaged.

Two other self-unloaders were turned out during the season: the steamer *John W. Boardman*, 350 feet long, expressly constructed for the rapid and economical handling of cement in bulk, and the collier *Glenelg* built at Midland with equipment for trade in the Welland Canal. The steamer *Dalrymple*, which completes the list of finished ship construction on the Lakes in 1923, is a Welland canal size steamer built for the grain and coal trades. The output of Lake yards in 1923 totaled 12 vessels, including two motorships, of 66,217 gross tons.

During the season of 1923 Lake shipyards also turned out the hulls of the two passenger steamers *Greater Detroit* and *Greater Buffalo*, the motorships *Twin Ports* and *Twin Cities* and three steamers of wooden construction. Twenty-nine steamers for Lake service were built in other yards. The three wooden steamers were built for the Hill Steamboat Company by the Sturgeon Bay Dry Dock Company for package freight trade on Lake Michigan. With the exception of the steamer *Sturgeon Bay*, which was built for the Shipping Board during the war, they are the first wooden cargo carriers to be built on the Lakes since 1905. They are 150 feet long overall, 30 feet molded beam, 17 feet molded depth with a gross tonnage of 763.

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Questions and Answers Relating to Naval Architecture and Marine Engineering

Conducted by James L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Disposal of U. S. S. Emeline

Q. (1,236).—What disposition was made of the U. S. S. *Emeline?* This yacht was taken over by the U. S. Government during the recent World War and immediately sent over seas for convoy duty. She was placed out of commission at the Marine Basin, South Brooklyn, New York, on May 18, 1919.

A. (1,236).—The steam yacht *Emeline* was sold by the Navy Department September 22, 1920, to Mr. R. T. Robinson of San Diego, California. She was turned over to her new owner October 10, 1920. I am unable to state in what service she is now employed.

Appendage Resistance in High Speed Ships

Q. (1.244).—What do you consider a reasonable allowance for appendage resistance, i.e., the resistance of rudder, shafting, etc., in vessels of high speed?

A. (1,244).—The following figures will give a fair idea of the relation between the appendage and the bare hull power for a destroyer and a scout at the values of speed length ratio shown. It is difficult to obtain accurate results from Model Basin tests both because of the care necessary in making and locating the model appendages with exactness to so small a scale and because of the small forces to be measured.

DESTROYER		SCOUT	
$V/\sqrt{L}$	Appendage power	$V/\sqrt{L}$	Appendage power
.866	.083	.81	.104
.924	.102	.85	.109
.982	.104	.89	.111
1.039	.110	.94	.130
1.097	.097	.98	.140
1.155	.097	1.02	.139

The figures given for appendage power are expressed as decimals of bare hull effective horsepower. The destroyer model was fitted with a rudder, two struts, two shafts, and two bilge keels of the single plate type.

The scout model was fitted with a rudder, two shafts, four struts and bilge keels of the built-up type.

Purposes for Which Two-, Three- and Four-Bladed Propellers Are Most Suitable

Q. (1,238).—For what purposes are 2-, 3- and 4-blade propellers most suitable?—F. V. G.

A. (1,238).—Two-bladed propellers are practically confined to small, high speed boats of low power where the thrust is low, the revolutions high and the diameter is not restricted and to auxiliaries in which, when operating under sail alone, the blades may be brought into the plane of and housed by the keel or deadwood so as to eliminate the resistance which would otherwise result from dragging them through the water.

The three-bladed wheel is now generally used for all classes of work, excepting where special conditions make four blades desirable. This is because of its somewhat greater efficiency and lower first cost. Where great area is required on a restricted diameter because of limitation in draft, hull clearance, etc., a four-bladed propeller may be used and, if properly designed, the loss in efficiency need not be great. Also, if the specified number of revolutions is too low for the use of a three-bladed propeller without getting into cavitation, a four-bladed propeller may be used to obtain the required revolutions without increase in diameter. Some authorities claim that a four-bladed wheel shows somewhat less vibration and more uniform turning moment than the three-bladed wheel. However, this would appear to depend somewhat upon the type of installation.

"Speed" and "Power" Wheels

Q. (1,237).—What is the difference between a so-called speed wheel and a so-called power wheel?

A. (1,237).—The term "speed wheel" generally implies high revolutions, small diameters and areas and low thrusts as distinguished from "power wheel" which usually implies low revolutions, large diameters and areas and great thrusts. These terms are sometimes used with much looseness.

Calculation of Sounding of Bottom Tanks

Q. (1,239).—Please inform me how to obtain the correct answer to the following question:

A ship 425 feet long between perpendiculars, double bottom tanks having a length of 69, 80, 32, 80 and 57 feet respectively, with sounding pipes in after end of each tank. What would be the correct sounding, if the ship has a 5-foot trim by the stern and the contents in tanks showed 36 inches on the sounding rod?—W. P.

A. (1,239).—In the absence of information to the contrary it is assumed that all the tanks are rectangular, both in the horizontal and the transverse vertical planes. The trim of the ship is $\frac{5}{425}$ or $\frac{1}{85}$ feet per running foot of ship. Hence, if the sounding be taken at the after end of the tank, the depth of the liquid would decrease $\frac{1}{85}$ foot (12/85 inch) for each foot length of tank. The mean or average depth of liquid in the tank would then be 36 inches minus ½ tank length (in feet) multiplied by 12/85. In the case of the 65 foot tank the correct sounding would be $36 - \frac{65}{2} \times \frac{12}{85} =$ 31 7/17 inches.

Advantages of the Cruiser Stern

Q. (1,243).—Why the cruiser stern which of late years has become so popular for many classes of vessels? To me its appearance is not pleasing and it would seem that there might be other disadvantages.

A. (1,243).—For a given length of waterline, the cruiser stern, if properly designed, gives greater effective length of underbody and therefore may be more easily driven than the ordinary type of overhanging stern.

It makes possible a larger value of BM, other things being equal, or an equal value of BM upon a smaller beam.

It gives more space within the hull.

However, it is very difficult, if not impossible, to design a cruiser stern for a vessel having the usual freeboard and avoid a heavy appearance aft.

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LETTERS TO THE EDITORS

Save the Oil

NEW YORK.

TO THE EDITORS:

Scandals unearthed in the "Teapot Dome" investigation pale into insignificance in comparison with the way in which Congress has jeopardized the bunker requirements of our merchant fleet. Oil reserves on the public domains should have been conserved for the use of our merchant ships as well as for our naval vessels. The new fleet built by the Shipping Board was primarily oil-burning and the future of bunker supplies for these ships is a public trust quite as grave as that which was imposed when the building of this fleet was authorized. Maritime supremacy depends upon much more than the possession of a fleet of ships. It depends likewise upon the ownership of adequate bunkers. The power of the British marine has in previous years been predicated in no small degree upon the fact that England owned the primary coal bunkering stations of the world. Inasmuch as it seems assured that the bunkers of the future will be oil instead of coal, it is incumbent upon our Government to preserve and conserve our oil supplies for the future need of our commerce and not to jeopardize it by leasing out rights to prospect to any one who presents credentials.

In June, 1914, on the eve of the World War the total merchant tonnage of the world amounted to but little over 49,000,000 gross tons. At that time only 1,721,747 gross tons of these ships burned oil, or about one-thirtieth of the total. England had discovered that oil as a marine fuel was admirably adapted to her navy, an innovation which was rapidly spreading to other nationals. Experience gained during the war taught the economies which result from the burning of oil aboard ships as a fuel for motive power. The scarcity of competent firemen, the ease of handling oil as compared with coal in the bunkers, and the gain in port time, hastened the adoption of oil fuel among the merchant marines of the world, consequently after the war the attention of naval architects and engineers had been universally drawn to fuel oil.

Before committing the Government to an extensive program of shipbuilding, however, the Shipping Board made a careful survey of the oil situation. It was found by consulting oil engineers who were then drafted into service that the supply of petroleum within the territorial confines of the United States would be exhausted within less than thirty years. That would compare favorably with the life of a ship and consequently the Shipping Board's building program was determined upon.

In the meantime England found herself possessed of oil reserves in Persia and other parts of the world and started adopting oil-burning equipment in her merchant marine. Countries which possessed no natural oil resources turned to Diesel engines for their ships. Statistics of shipbuilding clearly indicate this tendency. The Swedish countries were among those which began building Diesel-engined ships in numbers and now the rivalry for a merchant marine propelled by oil fuel entered a second era. It followed, therefore, that on June 30, 1923, the merchant fleets of the whole world totaled 65,166,238 gross tons, of which 16,478,101 tons, or something like one-fourth, burns oil, either under their steam boilers or in internal combustion engines. And the greater bulk of these oil-burners are owned either by England or by the United States. Our oil-burning merchant ships total over 9,000,000 gross tons, as against 4,271,000 gross tons under the British flag.

It is obvious from this that the American merchant fleet today is more dependent upon an adequate oil supply than the merchant fleet flying any other flag and [illegible] ships are more concerned with the proper conservation of our oil stocks. Yet in February, 1920, Congress enacted the land leasing law and permitted private concerns to draw off the oil in these public domains. These leases were handed out shortly after President Wilson became ill during the administrations of Secretaries Lane and Payne. Only the final remaining parcels were left to Secretary Fall to lease out.

Last summer the laid-up tonnage of the world was estimated to have been around 5,900,000 gross tons, of which 3,800,000 tons belonged to the Shipping Board. In other words, three-fifths of the idle merchant ships of the world are owned by our own Government. Our total merchant marine is estimated at 16,800,000 gross tons, of which over 9,000,000 gross tons burn oil. More than one-half of our ships, therefore, are dependent upon an adequate supply of fuel oil.

These comparative statistics certainly offer a serious problem and are indicative of the necessity for the adoption of a wise conservation policy in regard to our oil lands. If our own Government is going to refuse to preserve the future integrity of our bunker supplies, then it is incumbent upon our shipowners to take a lesson from Sweden and consider seriously the adoption of Diesel power.

V. G. IDEN.

Failure of Welds from Corrosion

NORFOLK, VA.

TO THE EDITORS:

Relative to a letter from Mr. T. F. Hagan to MARINE ENGINEERING AND SHIPPING AGE (published on page 123 of the February issue), commenting on Mr. Ewertz's articles on "Applications of Arc Welding to Ship Construction" with special reference to the failure of certain welds due to corrosion or oil action, I would like to state our experience in this connection:

About four years ago the Norfolk Navy Yard was informed that metal arc welds in fuel oil tanks were subject to corrosion and communicated with several individuals and concerns using welding in connection with containers for fuel oil. All information available pointed to the fact that fuel oil would not cause undue corrosion of the weld metal. The Norfolk yard has for several years been welding smothering lines, high and low suction lines, steam heating lines, vents, sounding tubes, heating coils in fuel oil tanks and hangers and clips for supporting these coils, etc. These heating coils in many cases are several hundred feet long and are made up as one continuous line, the joints of which are welded. In no instance has corrosion ever been noted.

It would appear that failure of the hangers and clips supporting the steam smothering lines referred to in Mr. Hagan's letter was due to poor workmanship, which involved possibly a dirty welding surface and too low a current to secure good fusion. The welder also might have been inexperienced on overhead welding, or the design of the welds might have been such that they were too light to withstand the working stresses of the ship.

Relative to the fact that welding should not be done in damp weather and that edges of the plate should be roughened instead of clean cut, I have seen good welds made when running water was in contact with the joint being welded. In this case a bead was run and then mechanically calked to stop the water and the joint surfaces were kept dry by heat conduction. The strength of the joint was in the subsequent layers of weld metal which were deposited. When it is realized that the highest temperature which can be secured is that of the electric arc and that this heat is great enough to entirely fuse through any thickness of metal, it would seem to be obvious that the roughening of a surface to secure good fusion would be entirely unnecessary. The primary consideration in this case would be to use suitable sized elec-

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trodes with a high enough current value to be assured of perfect fusion.

In view of the foregoing the failure of these welds will not indicate in the least the unsuitability of metal arc welding for ship construction, for it can be shown that welded joints can be consistently made stronger than any riveted joint, the problem being primarily that of good design, good workmanship and competent supervision.

JAMES W. OWENS, Electrical Engineer,
U. S. Navy Yard.

PERSONAL MENTION

W. H. SLADE has been appointed assistant to the European agent of the United States Lines and has left this country to take up his new duties.

FRED KENNEDY of Cleveland, O., has been appointed manager of the Reiss Steamship Company, Sheboygan, Wis., which operates 10 large steel ships.

A. G. JACKSON, JR., who recently resigned from the Emergency Fleet Corporation, has accepted a position with the Export Steamship Corporation of New York.

F. A. BAILEY, marine superintendent of the Pittsburgh Steamship Company, Cleveland, O., has resigned to take over the management of the Forest City Steamship Company.

R. R. PIPER has been made manager of the Manhattan office of the Morse Dry Dock Company of Brooklyn, N. Y. His new duties are in connection with the financial department of the company.

WALTER SCAMMEL has been appointed San Francisco agent for the Winslow Shipbuilding & Marine Railway Company, according to an announcement from the west coast. He will also represent Captain James Griffiths & Son at that city.

H. C. STROM of Duluth has been made traffic manager of the Pittsburgh Steamship Company, Cleveland, according to an announcement of A. F. Harvey, president of this company. He is succeeding A. H. Ferbert, who was recently elected vice-president.

JOHN M. BORN has been appointed agent of the United American Lines, intercoastal division, at Atlanta, Ga. His appointment is part of the general plan of the United American Lines to make Savannah a port of call for their intercoastal service.

JAMES SINCLAIR, at present head of the Far East and long voyage trades division of the Emergency Fleet Corporation in New York, has been transferred to the position of head of the European and Mediterranean trades division succeeding A. G. Jackson, Jr., recently resigned.

CAPTAIN FRED J. SIMPSON, who has been in the service of the Detroit & Cleveland Navigation Company at Detroit for 34 years, has resigned to become general manager of the Detroit & Windsor Ferry Company. For several years he has been shore captain at Detroit for the D. & C.

PERCY E. BOURKE, passenger and freight representative in Detroit for the Anchor Line and the Great Lakes Transit Company for 35 years, has resigned to become traffic manager of the Ashley & Dustin Steamer Line of Detroit. Mr. Bourke was also elected secretary and a director of the company.

EDWARD FORD has been appointed general manager in charge of operations by President Gale Carter of the Pacific Mail Steamship Company. The work will include the handling of the Shipping Board's combined passenger and freight liners in the transpacific service. Mr. Ford will also continue to direct the business of the Grace Line on the Pacific coast. Mr. Carter has also announced that Thomas A. Graham, who became vice-president and general manager of the Pacific Mail on September 1 last, will now have the title of vice-president.

W. S. HILL, appointed commissioner of the United States Shipping Board from the Middle West, was born on June 3, 1863. He was educated in high school and business college and, after becoming of age, engaged in selling agricultural implements and dealing in coal in South Dakota. He later became interested in farming and live stock raising and at present operates a 1,520-acre farm in South Dakota. Since 1914 he has been president of the Security National Bank of Alexandria, South Dakota. He is also president of the Hill-Taylor Company, of Alexandria, a company dealing in agricultural implements; of the Dakota Improved Seed Company, Mitchell, South Dakota, and a director of the Western National Bank at Mitchell. Since 1906, he has been a member of the South Dakota State Board of Agriculture and president of this Board since 1912. During the war he was a member of the State Council of Defense and was connected with various war activities in the state of South Dakota.

W. S. Hill

T. V. O'CONNOR has been designated by President Coolidge as chairman of the United States Shipping Board. He has resided in Buffalo practically all his life, having been a resident of that city since 1872. In early life he was employed as a fireman on a harbor tug at the port of Buffalo, later obtaining a license as marine engineer and as master. In the year 1906 he was elected president of the Licensed Tugmen's Protective Association of the Great Lakes, which position he held until 1908, when he was made president of the International Longshoremen's Association, remaining in that position until June 15, 1921. During the war he served as a member of the National Adjustment Commission, which was a war board established for the fixing of wages and conditions in the longshore industry. For many years Mr. O'Connor has been more or less active in political affairs in his home city and state. In 1921 he was appointed by Nathan L. Miller, Governor of New York, one of the members of the State Industrial Board, which office he resigned upon his appointment as commissioner of the Shipping Board, by President Harding, in 1921. He was chosen vice-chairman of the Shipping Board June, 1921, and he has served in that capacity until his designation as chairman.

T. V. O'Connor

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CAPT. W. P. MCELROY has been appointed shore captain of the Pittsburgh Steamship Company, Cleveland, O. Capt. McElroy was master of the steamer *D. G. Kerr* last season.

E. A. WURTSER, one of the organizers of the Falk Corporation, and its secretary and treasurer since its inception in 1895, has retired and Clarence R. Falk has been appointed as his successor.

DR. JOHOW-FOERSTER, the eminent German engineer, is expected to arrive in this country about the middle of May. Dr. Foerster's visit is in behalf of German marine interests and he is also expected to assist the Theodore Goldschmidt Corporation, New York, with some of its marine affairs.

E. C. PLUMMER, United States Shipping Board commissioner, has been elected vice-chairman of the Board. In announcing this election T. V. O'Connor, chairman of the Board, stated that Mr. Plummer's valuable work with the Shipping Board during the past few years is well known and the Board is exceedingly fortunate in having his sound, practical knowledge of shipping problems to aid it in its work.

HARRY G. SKINNER, whose election as president of the Vulcan Iron Works, Inc., Jersey City, N. J., was announced in the February issue of MARINE ENGINEERING AND SHIPPING AGE, comes from a family which has been in the shipbuilding and repair business for more than a century. He served his apprenticeship with the firm of William Skinner & Sons of Baltimore, Md., of which his father was the senior member. After his apprenticeship he continued working at the business of shipbuilding and repairing until the death of his father in 1891, when he assumed the management of the plant. In 1899 he incorporated under the name of the William Skinner & Sons Shipbuilding & Dry Dock Company, and constructed what was at that time the largest graving dock in this country. It was 600 feet in length and had 22½ feet of water over the keel blocks. Mr. Skinner was the principal owner and president of this corporation. In 1906 the William Skinner & Sons Shipbuilding & Dry Dock Company purchased the Baltimore Shipbuilding & Dry Dock Company and consolidated the two companies under the name of the Skinner Shipbuilding & Dry Dock Company. During the war Mr. Skinner was very active in war work, holding the position of marine superintendent of the Expeditionary Depot out of Baltimore. After his activities in this line ceased he was connected with the United States Shipping Board, Emergency Fleet Corporation, in connection with the settlement of claims. In 1920 he became a member of the Construction Claims Board and while acting in this capacity was partly instrumental in settling many of the large claims against the Fleet Corporation, remaining with the Fleet Corporation until June, 1923.

Harry G. Skinner

OBITUARY

HENRY K. MASTER, aged 54, for more than 20 years superintendent of the Booth Steamship Company, New York, died February 6 at his home in Brooklyn.

CLARENCE THORNE SNYDER, vice presider[illegible] Atlantic Lighterage Corporation, New York, died February 11 at the Muhlenberg Hospital, Plainfield, N. J.

A. H. BATTEY, associate editor of *The Marine Journal*, died at his home in Brooklyn, January 27. Mr. Battey was born in Nantucket, Mass., a member of a seafaring family. As a boy he went to sea, later becoming a licensed officer. After giving up the sea, he became a printer and took up newspaper work, holding the editorship of the tri-weekly *Tribune* until that paper was discontinued. He was employed in various capacities on the *Tribune* staff. In October, 1919, he became associated with the staff of MARINE ENGINEERING AND SHIPPING AGE and late in 1920 was made managing editor of *The Marine Journal*. For a brief period he undertook independent newspaper and magazine writing, but rejoined the staff of *The Marine Journal* when that publication changed ownership in 1922. He continued on the staff of this journal until his death.

CHARLES C. GARRISON, engineer of the Hudson River Day Line steamboat *Albany*, died at his home in Athens, N. Y., February 11. He was 36 years of age at the time of his death.

CAPTAIN H. L. HIGGINS, aged 80 years, formerly employed by the Southern Pacific Company, died at Radnor, Pa., February 6. He joined the staff of the Southern Pacific Company in 1883 and retired in 1910.

JENKHEER L. P. D. OP TEN NOORT, president of the famous Werkspoor Engineering Company, recently died at Baarn, Holland, at the age of 76. In addition to his connection with the Werkspoor Company, this veteran of Dutch shipping was a director of the Netherlands Shipbuilding Company, besides being associated with several shipping firms of importance.

CAPTAIN HUGO W. BEHREND, president of the Union Transport Company, Inc., New York, recently died at the Fifth Avenue Hospital, Manhattan. Mr. Behrend was considered an expert in handling ships and an authority on ocean shipping. He was extensively interested in the success of the new city piers at Staten Island and is said to have been the only lessee making use of the piers.

HOWARD C. HIGGINS, who resigned in December, 1923, as district agent at Philadelphia of the United States Shipping Board and the Emergency Fleet Corporation, because of ill health, died at his home in Radnor, Pa., on February 7. He served his apprenticeship as a machinist at the William Cramp & Sons Ship & Engine Building Company, Philadelphia. He went to sea as an engineer serving principally in vessels of the American Line, and later occupying the position of superintending engineer of the Chesapeake Line. In 1901 Mr. Higgins left the service of that company to become superintending engineer of the Old Dominion Steamship Company where he continued until the outbreak of the war when he joined the United States Shipping Board and served as a special representative of the Board at the Submarine Boat and Hog Island Shipyards. He resigned from the latter position in 1919 and was appointed district agent at Philadelphia of the United States Shipping Board and Emergency Fleet Corporation. He was a member of the Society of Naval Architects and Marine Engineers, the Engineers Club and the committee on engineering of the American Bureau of Shipping.

H. C. Higgins

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The Month's Shipping and Shipbuilding News in Brief

Shipyard, Steamship and Port Activities and Other Notes of Interest in All Branches of the Marine Industries

Southern Pacific to Build Two New Turbine Freighters

PLANS and specifications have been completed for the construction of a new single screw freighter for the Southern Pacific Steamship Company and bids will probably be opened in the near future. It is also possible that two ships, which would have a total cost of approximately $3,000,000, may be built from the plans to be submitted to builders.

The specifications for the new vessel call for a ship having an overall length of 433 feet, length between perpendiculars 415 feet, beam molded 56 feet, depth molded to hurricane deck 37 feet, depth to main deck 28 feet, mean draft loaded 26 feet, total deadweight capacity 7,960 tons.

The propelling machinery will consist of compound turbine engines fitted with double reduction gears, steam being supplied by water tube boilers of the Babcock & Wilcox type capable of generating steam at a pressure of 250 pounds. The boilers will be oil burning and the steam will be superheated at 150 degrees. There will be approximately 6,000 indicated horsepower, the ship developing a speed of over 14 knots.

The proposed freighter has been designed by A. S. Hebble, Superintending Engineer of the Southern Pacific Company, and will have a straight stem and elliptical stern, rigged with steel pole masts and two steel derrick posts to which wooden cargo booms of 7½ tons' capacity will be attached. There are to be three complete steel decks, fore and aft, with an orlop deck forward.

Although the specifications call for steam driven auxiliaries, it is understood that electrically driven auxiliaries will receive consideration before a contract is awarded.

Shipowners on Great Lakes Plan Construction of New Ships to Cost $10,000,000—Orders Expected Soon

THE construction of approximately $10,000,000 worth of new vessels, principally freight ships and passenger and automobile ferries, for Great Lakes service is under contemplation and some of the business is rapidly nearing the contract stage, according to exclusive information obtained by MARINE ENGINEERING AND SHIPPING AGE.

With the Lakes district already astir with preliminary preparations for the Spring rush shipyards and equipment manufacturers will be deeply interested in the reports of coming activities.

Foremost among the announcements receiving credence is the report that the Ford Motor Company of Detroit is considering the building of four more cargo ships, and another statement that the U. S. Steel Corporation is planning the building of a 17,000 ton freighter to carry stone from Calcite to Buffington. It is estimated that over $5,000,000 would be spent in the building of these vessels.

The Mitchell Steamship Company of Cleveland, Ohio, is reported as contemplating the construction of two million-dollar ore freighters, each of about 14,000 tons, and the Grand Trunk Western Railway Company, Montreal, is mentioned as in the market for two new car ferries. These latter vessels are to be of the three track type carrying about 21 cars each for service between Ludington and Milwaukee and will cost close to a million dollars apiece.

The Detroit & Windsor Ferry Company, of Detroit, Michigan, is said to be planning a new ferry which will cost about $750,000.

The Wolverine Drydock Company, Port Huron, Michigan, has a contract to rebuild the steamer *City of Sheboygan* adding 15 feet to the vessel's length and 8 feet to her beam. This work will cost over $50,000.

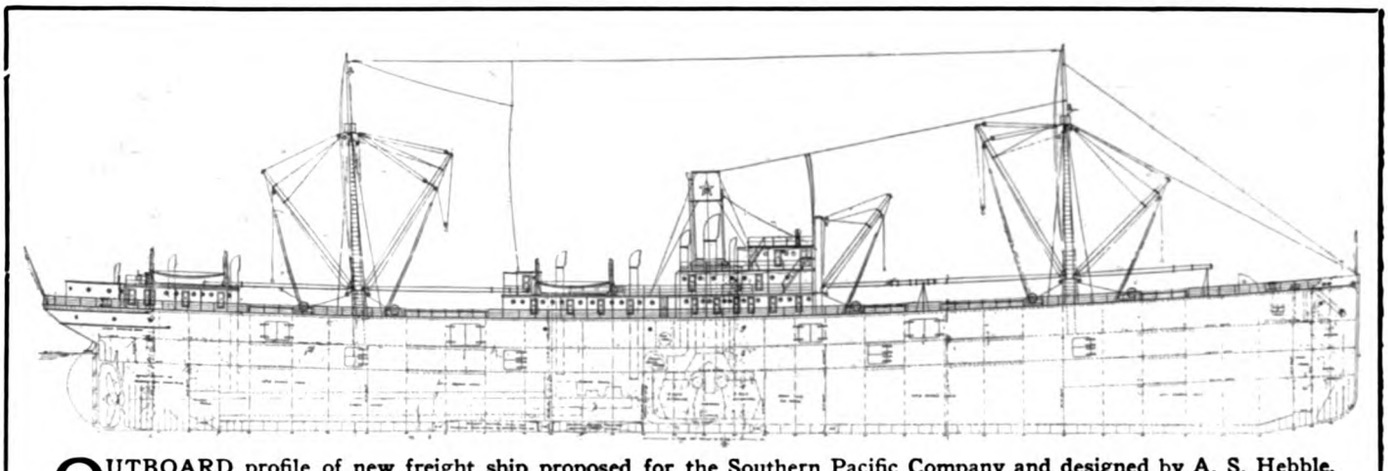
Bids have been asked by the Minnesota & New York Steamship Company for the construction of a 600 foot dock equipped with modern freight handling machinery.

Towing Company Buys Repair Plant

The plant of the Wilmington Marine Railway Company, located on Eagles Island, Wilmington, N. C., has been purchased by the Stone Towing Company and in the future is to be operated as a commercial modern ship repair plant. The company owns and operates a large fleet of tugs and barges and in the future all of them will receive their repairs at the newly acquired plant.

Two New Vessels May Be Built For Arctic Service

Announcement is made from Vancouver, B. C., that the Hudson's Bay Company is planning to build two new vessels for use in the Arctic, the larger to be of steel construction probably having steam for power with oil burning boilers, while the smaller vessel will be of about 150 tons capacity and will be used as a distributing vessel from Herschel Island eastward to Coronation Gulf.



OUTBOARD profile of new freight ship proposed for the Southern Pacific Company and designed by A. S. Hebble, Superintending Engineer. The vessel will have an overall length of 433 feet; length between perpendiculars 415 feet; beam molded 56 feet; depth molded to hurricane deck 37 feet; depth to main deck 28 feet; draft loaded 26 feet; total deadweight capacity 7,960 tons. Propulsion will be by turbine engines fitted with double reduction gears, steam being supplied by watertube boilers. Bids will be taken in the near future.

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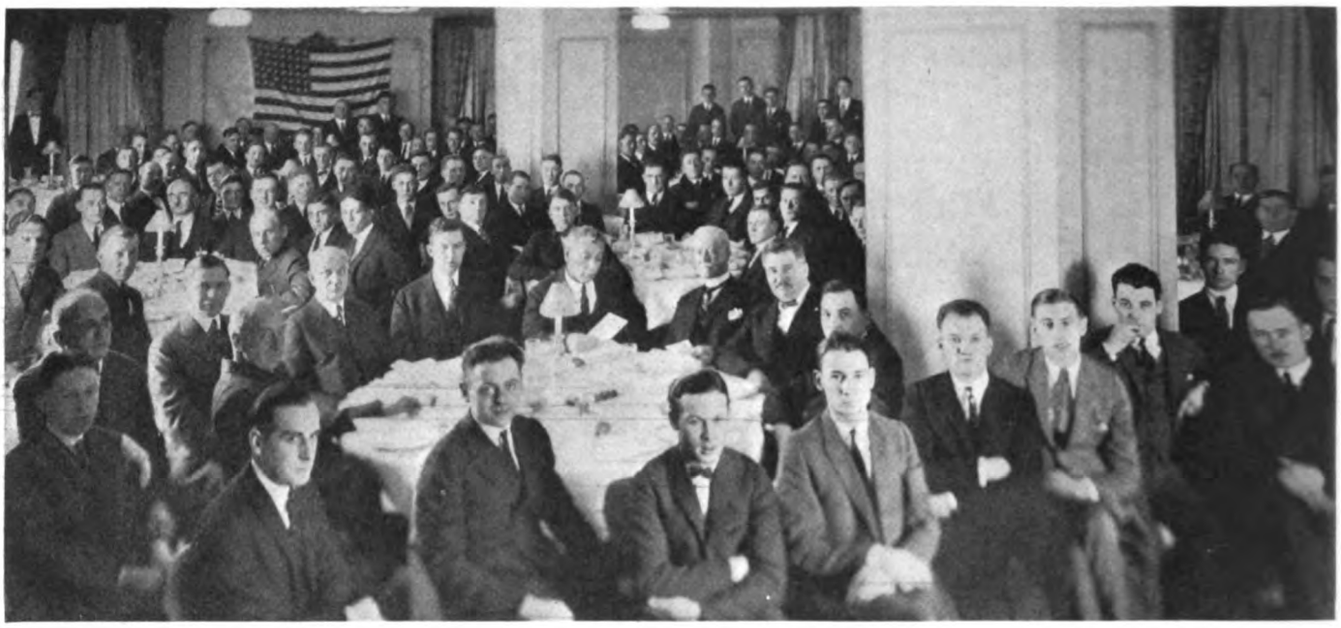

Annual Dinner Given by Lake Carriers' Association at Hotel Cleveland, Cleveland, O., on February 5 to Students of the Lake Carriers' School for Marine Engineers and Navigators

Bids Next Month at Louisville, Ky., for 5 Maneuver Hulls

THE United States Engineer Office, Louisville, Ky., expects to take bids in the latter part of March for five steel hulls for maneuver boats. Alternate bids will be taken on one or three hulls. Deliveries are to be made as follows, on the Ohio River: One, at Marietta, Ohio, for the U. S. Engineer Office, Huntington, W. Va.; three, at Fernbank, Ohio, for the U. S. Engineer Office, Cincinnati, Ohio; one, at Louisville, Ky., for U. S. Engineer Office, Louisville, Ky.

The dimensions of the hulls are: Length 60 feet, beam 26 feet, depth at gunwales 3 feet 7½ inches. Each hull will have two watertight bulkheads and six structural steel casings, 14 inches by 14 inches, for spud wells. The deck fittings will consist of eleven double chock kevels, two double chocks, and seven single chocks, all of cast steel.

Small Ferryboat Wanted

The New Hanover & Brunswick Counties, Wilmington, N. C., are reported as in the market for a second-hand ferryboat. The steamer *John Knox*, a small double ender of about 100 tons, is at present operated and one double the size, oil burner preferred, is desired. Addison Hewlett, Chairman, County Commissioners for New Hanover County, Wilmington, N. C., may be addressed for further particulars.

May Build Coal Fleet

The Interstate Public Service Company, Indianapolis, Ind., is considering constructing and operating its own coal fleet for its proposed $10,000,000 power station on the Indiana side of the Ohio River, a few miles above Louisville, Ky.

Diesel Tug Jumbo on Exhibition Run

THE Diesel-engined tug *Jumbo*, which was put into service in New York harbor in January, was given an exhibition trial in the presence of several marine engineers and towboat operators on February 25.

This vessel, owned by the Transmarine Mercantile Corporation, is the largest Diesel tug in the United States, the principal dimensions being as follows:

Length overall	100 feet
Breadth	26 feet
Draft:	
Forward	10 feet
Aft	12 feet

The hull, which is of wood, is of the usual towboat type but of larger size and heavier construction than is customary in harbor tugs.

The propelling machinery, built and installed by the New London Ship & Engine Company, consists of a six cylinder, four cycle Nelseco engine of 600 brake horsepower with complete electrically-driven auxiliaries, the latter being furnished by the Electro-Dynamic Company. The auxiliaries comprise circulating water, lubricating oil, fuel transfer and bilge and fire pumps, as well as direct motor-driven steering gear and gypsies for handling lines. An auxiliary generator and air compressor driven by a 7½ horsepower Mianus heavy oil engine, and a 110-volt, 128 ampere storage battery are also installed. For supplying current to charge batteries when underway a 5 K.W. generator is driven off the main shaft.

The bunker oil capacity, about 45 tons, is sufficient for 350 hours' operation. The boat handles and maneuvers very well, and meets the severe requirements of harbor towing in an entirely satisfactory manner. To test its maneuvering ability, the engine was reversed continuously for a long period, the engineer getting 385 bell signals in succession. No lack of maneuvering air was experienced and it was not necessary to operate the auxiliary air compressor. This test would appear to set at rest the doubts which we have occasionally heard expressed as to the possibility of maneuvering a Diesel engine continuously or at frequent intervals, as is often required in towing service.

Motor Tug Jumbo, Largest of the Type in the United States

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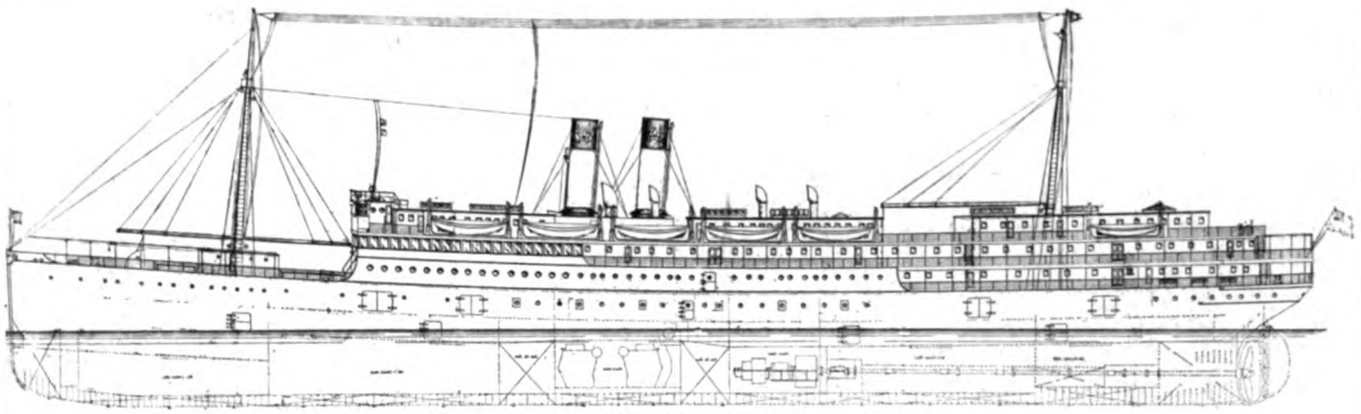

Profile of S. P. Ship Now Under Construction

Boiler and Pump Bids Open March 14 at Memphis, Tenn.

SEALED proposals will be received in duplicate at the office of the Mississippi River Commission, First and Second Districts, Room 1006 McCall Building, Memphis, Tenn., until 11 A. M., March 14, 1924, for furnishing and delivering one centrifugal sand pump and engine. The pump will be direct-connected to a double vertical engine, mounted on a rigid cast iron bed plate, the pump to have a speed not exceeding 250 revolutions per minute, against a total head of 35 feet, 10 feet of which is suction head. It is to deliver not less than 80 cubic yards of sand and gravel per hour on the basis of 10 percent of the output of the pump being solids.

The same office will receive bids, in duplicate, until 11 A. M., on the same day, for furnishing and delivering one horizontal boiler and one boiler feed pump. The boiler is to be horizontal, internally fired, self-contained, portable return tubular type with steam dome, 85 horsepower capacity, and is to be complete in every respect. The pump is to handle 5,000 pounds of water per hour and is not to exceed 30 strokes per minute per plunger.

Contract to Lengthen Two Steamers Awarded Great Lakes Plant

THE Great Lakes Engineering Works, River Rouge, Mich., recently closed a contract for the reconstruction, for the State of Michigan, of the steamers *Colonel Card* and *Colonel Pond*. The vessels were built for the United States Quartermaster's Department.

The steamers are 130 feet long overall, 28 feet beam, equipped with fore and aft compound steam engines turning twin screws. Each vessel will be lengthened 49 feet 6 inches, a portion of the superstructure will be cut away, leaving an open deck forward. All cabins on the main deck will be cleared out, except the engine and boiler casing. The entire main deck will be left clear for carrying automobiles, the headroom under the saloon deck being 7 feet 10 inches.

The ferries run between Mackinaw and St. Ignace and form a connecting link in the highway systems of the Lower and Upper Peninsulas of Michigan.

New Passenger and Freight Ship for Southern Pacific To Be One of Most Modern Design and Equipment

THE Southern Pacific Company, Atlantic Steamship Lines, has recently contracted with the Todd Dry Dock and Construction Corporation, of Tacoma, for a large freight and passenger steamer for the New York-New Orleans service. The vessel as designed will be of the most modern and up-to-date type ever constructed for Atlantic coastwise service. The passenger accommodations and public spaces throughout will be commodious, well ventilated and of a design and arrangement not hitherto found in this class of vessel.

The ship will have passenger accommodations for first class and steerage passengers only. The plans call for 237 first cabin and 111 in steerage. The crew will consist of 24 in the deck department, 24 in the engine department, and 66 in the steward's department. All rooms for first-class passengers will be outside rooms, to insure comfort and ventilation in warm weather. They will be divided into suites with twin beds, suites with double beds, and ordinary rooms with stationary single beds and folding upper berths and settee berths.

TYPE OF VESSEL

The ship will be of the hurricane deck type, with straight stem, semi-elliptical stern, and rigged with two pole masts and two smoke stacks. She will have three complete steel decks, fore and aft, and a steel promenade deck, with an orlop deck in addition to the forward hold.

The superstructure will contain first cabin accommodations, music room, dining room, social hall, smoking room, lounge, and barber shop.

The steerage passengers will be accommodated forward on the hurricane deck. The deck and engineer officers' quarters, together with the mess room and hospital and wireless room, will be located on the boat deck, around the engine room casing and forward of the boiler room casing.

The main steering gear will consist of a right and left hand type screw gear. The auxiliary gear will be hydro-electric type and capable of steering the vessel under all conditions.

Cooled drinking water will be circulated throughout the passengers' and crews' quarters. The public spaces, halls and passageways will be heated by steam, and the staterooms by the electro-vapor system. Special attention has been given to ventilation of public spaces and passengers' and crews' quarters. Electric fans will be provided in all staterooms and bath rooms to insure keeping these places cool in southern waters. A complete annunciator call bell system is provided for all rooms and public spaces.

DIMENSIONS AND PROPULSION

The vessel will be of the following general dimensions:

Length overall	445 ft.
Length between perpendiculars	427 ft.
Beam moulded	57 ft.
Depth moulded to hurricane deck	37′ 6″
Designed loaded draft	25′ 6″
Dead weight capacity	tons 7,000

The propelling machinery will consist of De Laval compound turbines with double reduction gear, the turbines being designed for 7,100 shaft horsepower at 85 revolutions per minute of the propeller shaft.

The boiler equipment will consist of six Babcock & Wilcox small tube type water-tube marine boilers, equipped to burn fuel oil. The boilers will set fore and aft, with a center fire room. They will be fitted to operate under forced draft, with fans located in the 'tween decks above the boilers. All the usual engine and fire room auxiliaries will be fitted. The electric light plant will consist of two 50 and one 25 kilowatt reciprocating engine-driven generating sets.

The vessel's designed sea speed is 15½ knots. She is arranged to handle cargo economically and expeditiously and is fitted with 10 double cylinder cargo hoisters. The arrangement calls for 6 hatches and 8 side ports on each side.

The vessel was designed by and will be built under the supervision of A. S. Hebble, Superintending Engineer of the Southern Pacific Company, under the direction of C. W. Jungen, Manager.

Two Oil Barges Building for Hudson Day Line

The Hudson River Day Line, New York, has placed an order with the Sparrows Point Plant of the Bethlehem Shipbuilding Corporation, Ltd., for two steel oil barges 100 feet long by 18 feet beam by 9 feet 6 inches depth, each with a capacity of 2,100 barrels, to be delivered about May 1.

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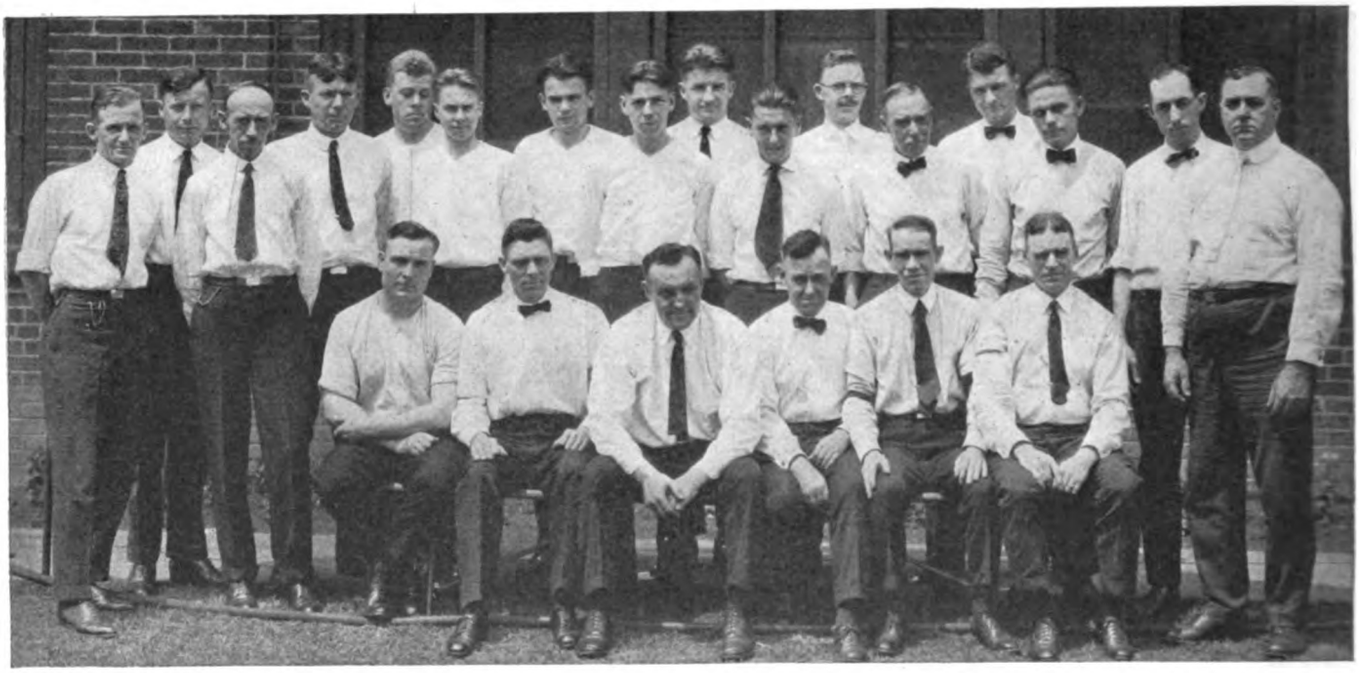

One of the Classes of Merchant Marine Engineers at the Shipping Board Fuel Oil School, Philadelphia Navy Yard

(Standing, Left to Right) C. Tucker, A. W. Jackson, T. Winlaw, W. H. Muchlhouse, C. A. Peterson, E. O. Mejo, F. T. Beiderbeke, E. H. Garey, J. E. Delaney, E. E. Birkinshaw, C. E. Smith, R. N. Robinson, E. P. Forrestel, C. S. Adams, R. C Brierly (Technical Aide, U S. N.), M. A. Parker. (Seated, Left to Right) G. E. Harrington, E. Whitfield, Lt.-Comdr. H. H. Norton, U. S. N., Commanding Officer, Fuel Oil Test Plant, K. L. Hanson, G. H. Sheppard, H. E. Strubing.

Four Towboats, Two Dredges and Various Equipment Planned

ACCORDING to information obtained by MARINE ENGINEERING AND SHIPPING AGE, the General Contracting Corporation, with offices in the Columbia Bank Building, Pittsburgh, Pa., is preparing plans for the construction of one 200-horsepower oil burning towboat, steel hull; also, one steel hull dredge boat, one steel hull derrick boat and two steel hull dump scows. This company has the contract for constructing the power plant for the Ohio River Edison Company at Toronto, Ohio.

New $750,000 Fleet

The Pittsburgh Plate Glass Company, Pittsburgh, Pa., which at present is constructing the most modern factory at Creighton, on the Alleghany River, Pa., will in the near future draw plans for a new river fleet to cost more than $750,000. This will include a modern sand and gravel dredge, steamboat and barges.

Towboat for Carnegie Steel

The Carnegie Steel Company, of Pittsburgh, will in the near future ask bids for the construction of a large all-steel towboat, plans for which now are under way. This boat is to be used to tow the company's steel products to New Orleans and intermediate southern ports.

Oil Burning Towboat Planned

The McClain Sand Company, Point Marion, Pa., plans a new towboat, 75 feet long, with 100 horsepower oil burning engine.

New York City Plans Construction of Three Modern Hydraulic Dredges; Appropriation of $1,454,100 Asked

WHAT is considered as the first step in the ultimate construction of a fleet of modernly equipped dredges and auxiliary plant, the building and outfitting of which will cost many millions of dollars, is seen in the application of the Department of Docks of the City of New York to the Board of Commissioners of the Sinking Fund for an issue of corporate stock to the amount of $1,454,100 for three hydraulic dredges and plants, chargeable to the Jamaica Bay improvements.

The request for this fund is prompted by the fact that the Dock Department believes that under existing conditions it is almost impossible to procure from private dredging concerns reasonable bids for dredging work in Jamaica Bay. In its communication, dated January 27, 1924, the Department cites bids received on November 30, 1923, for channel and fill work, which it considers excessive. Commissioner Delaney states that a city-owned plant will insure a reasonable cost as well as uninterrupted progress of the work.

PRESENT REQUIREMENTS

The Department of Docks is ready to submit to the Board specifications and form of contract so prepared as to permit the award of a contract for one, two or three of the dredges as the interests of the city may appear after the bidding. The requirements and estimates of costs are as follows:

1 dredge with following plant and equipment:
- 4,000 feet 20-inch pontoon pipe line
- 4,000 feet 20-inch shore pipe line
- 1—20 ton steel water barge
- 1—100 ton oil fuel barge
- Derrick boat
- 1 small gasoline launch
- 1—100 horsepower oil engine tug for barges, etc.
- 1 portable acetylene plant

Total estimated cost.....$550,200

2 dredges with following plant and equipment:
- 6,000 feet 20-inch pontoon line
- 8,500 feet 20-inch shore line
- 1—60 ton steel water barge
- 2—100 ton oil fuel barges
- 2 derrick boats
- 2 small gasoline launches
- 1—100 horsepower oil engine tug for barges, etc.
- 2 portable acetylene plants

Total estimated cost.....$992,650

3 dredges with following plant and equipment:
- 8,000 feet 20-inch pontoon line
- 13,000 feet 20-inch shore line
- 1—60 ton water barge
- 2—100 ton oil fuel barges
- 2 derrick boats
- 3 small gasoline launches
- 2—100 horsepower oil engine tugs
- 3 portable acetylene plants

Total estimated cost.....$1,454,100

Derrick Boat

U. S. Engineer Office, Detroit, Mich., has prepared plans for a steel hull derrick boat, bids for which will be advertised shortly.

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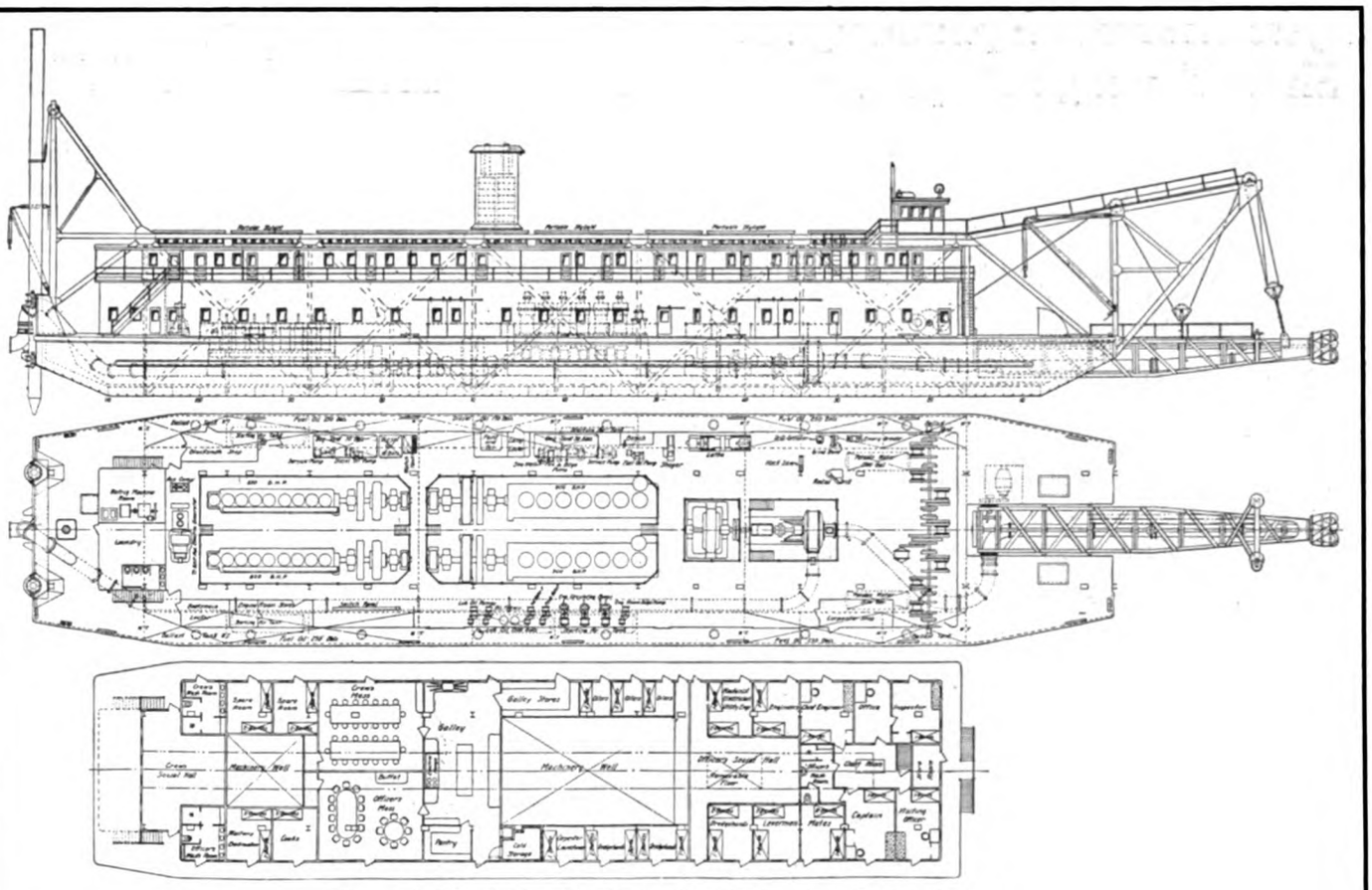

Plans of Diesel Electric Hydraulic Dredge for Portland, Ore.

N. Y. Shipbuilding Corp. Lowest Bidder for Five Steel Carfloats

BIDS for the construction of five 2-track steel car floats, 16-car capacity, were opened in the office of W. B. Pollock, manager, Marine Department, the New York Central Railroad Company, 6 Beaver Street, New York City, at 12 M., February 8. The boats will have a length of 366 feet, breadth 38 feet and depth 11 feet. The tenders were as follows:

New York Shipbuilding Corp.	$598,750
Bethlehem Shipbuilding Corp.	638,750
Cramp Ship & Engine Bldg. Co.	659,000
Federal Shipbuilding Co.	662,000
Sun Shipbuilding & Drydock Co.	680,000
Newport News Shipbuilding Co.	710,000
Staten Island Shipbuilding Co.	780,000
Todd Shipyards Corporation	784,900

Bethlehem Offers Lowest Price for 2 C. N. J. Carfloats

THE Bethlehem Shipbuilding Corporation, with a price of $199,000, submitted the lowest bid for the construction of two steel carfloats for the Central Railroad of New Jersey at the opening of tenders at Pier 11, North River, on February 15th. The carfloats are to be of the 3-track type, having a length of 325 feet, beam 36 feet 6 inches, depth 10 feet 8 inches.

Bids Open March 15 for Constructing Steel Hull Complete for a 30-Inch Diesel Electric Pipe Line Dredge

PROPOSALS for the construction of a steel hull, complete and ready for the installation of machinery, for a 30-inch Diesel electric hydraulic pipe line dredge for the Port of Portland, Oregon, are to be filed at the office of the Board, 916 Spalding Building, not later than 11 a. m., on March 15. James H. Polhemus is general manager and chief engineer in charge.

The hull is to have a length of 236 feet, beam 50 feet and depth 12 feet 9 inches. It is to be constructed with three transverse bulkheads one-quarter inch thick and one in the well three-eighths of an inch thick. The two in the bulkheads will extend to the side of the hull and the two intermediate will extend to the side of the longitudinal bulkheads. The deckhouse is to be of steel. Foundations are to be provided for the engines, pumps and other auxiliary machinery.

MACHINERY AND EQUIPMENT

Although the specification does not include machinery or auxiliaries, the plans for the boat call for two 900 brake horsepower and two 800 brake horsepower main engines; service pumps; Diesel oil pumps; lathe, shaper, drill grinder, engine circulation pumps, bilge pumps, oil pumps, refrigerating machinery, laundry, etc.

METHOD OF BIDDING

Proposals for the dredge, which will be named the *Clackamas*, will be considered as follows:

(a) For furnishing all labor and material, building and delivering hull, trusses and house complete and as specified.

Alternate (b) Furnishing, fabricating and delivering f. o. b., wharf Portland, Oregon, all material for hull, trusses and house complete except field rivets and wood material. This includes all drawings, drafting and engineering work required by the specifications.

Alternate (c) Furnishing all labor for handling, hauling and building hull, trusses and house, furnishing all material and labor not furnished by the fabricator under alternate (b).

Oil Burning Towboat Replacement

The McClain Sand Company, of Point Marion, Pa., on the Monongahela River, is considering the construction of an oil-burning towboat to replace its steamboat *Marion*, which sank in the mouth of the Cheat River about four weeks ago.

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Lloyd's Annual Shipbuilding Returns Show Tonnage Output Lowest Since 1909

THE shipyards of the world last year launched less than half as much tonnage of merchant vessels as they did in the last pre-war year, 1913, says a statement just issued by Lloyd's Register of Shipping, covering returns from all maritime countries for 1923. Compared with launchings for 1913, aggregating 3,332,000 gross tons, it is pointed out, last year's total was only 1,643,000 tons.

Last year's figures, Lloyd's Register adds, also show a sharp decline from those of the previous year, and, with the exception of 1915, are the lowest on record since 1909. And, excluding these two years, the 1923 total is lower than for any year since 1897. It should be noted, however, that the returns showing tonnage under construction at the beginning of this year showed some increase over the quarter ending September 30, last.

The falling off in construction work last year was general, the only country for which an increase is reported being the United States, where about 53,000 gross tons more were launched than in 1922. This, however, compares with a decrease of about 385,000 tons for Great Britain and Ireland and of almost half a million tons for all the other shipbuilding countries combined. Lloyd's Register gives the following table, showing the total of launchings for the two years, in gross tons:

	1923	1922
United States	172,817	119,138
Great Britain and Ireland	645,651	1,031,081
Other countries	824,713	1,316,865
World total	1,643,181	2,467,084

The increase in the American output last year marks the first break in a continuous period of decline since 1919, the statement adds, and it is pointed out that, whereas the launchings for this country were 912,000 gross tons less than for Great Britain and Ireland in 1922, they were only 472,000 tons less for last year. And, whereas American shipyards launched almost 1,200,000 tons less in 1922 than all the other countries combined, excepting Great Britain and Ireland, in 1923 our shipbuilders launched only about 650,000 tons less. These figures reflect the sharp shrinkage in tonnage abroad during the last year.

While the United States has made a slight gain in comparison with the pre-war position, the small maritime countries have made a sharp advance in their share of world shipbuilding, and British yards have fallen back nearly 20 percent.

Last year brought a continuance in the sharp decline in tanker construction, says Lloyd's Register. In 1921 more than a million gross tons of oil-carriers were launched; but the 1922 figures were only about a third of that, while 1923's total was only about a third of that for 1922. While last year's decline was general, the British shrinkage was by far the greatest, as the following comparison in gross tons for the last two years shows:

	1923	1922
United States	9,862	14,440
Great Britain and Ireland	58,188	262,826
Others	58,131	78,588
World total	126,181	355,854

In 1922, more than 70 percent of the world's tanker building was in British yards, but last year her proportion was only about 45 percent.

An increase was shown in 1923 in the construction of motorships, the world launchings of vessels equipped with internal combustion engines totaling 226,000 gross tons, as compared with 209,000 tons in 1922. Launchings of motorships in Great Britain and Ireland represented 87,244 tons last year. In 1921 the world figures for motor vessels launched were 306,000 tons.

In contrast with the gain in motorship construction, a marked decline is shown in the construction of vessels fitted with turbines. While 1,195,000 gross tons of ships of this type were launched throughout the world in 1921, and 776,000 tons in 1922, the total for 1923 was only 304,000 tons. While in 1921, therefore, the launched tonnage of vessels with turbines was nearly four times that of motorships, last year the turbine's former lead over motorship construction of about 900,000 tons was cut to less than 100,000 tons.

Diesel-Electric Drive for Great Lakes Dredge

THE first commercial, privately owned Diesel-electric hopper dredge will be put into operation on the Great Lakes by the Construction Materials Company of Chicago during the present year. Orders have been placed with the General Electric Company for complete electrical equipment to be installed in the *Lake Weir*, which will be converted for this purpose. The construction Materials Company will use the boat for dredging and also for transporting and delivering construction materials for building purposes. The boat will be the first Diesel-electric dredge in operation on the Great Lakes.

The propulsion equipment consists of two 600 brake horsepower Diesel engines built by the Worthington Pump and Machinery Corporation each direct-connected to a 400-kilowatt main generator and a 35-kilowatt auxiliary generator. Under normal operating conditions each main generator will drive a 500 horsepower motor direct-connected to a propeller, the craft being of a twin-screw type. Ward-Leonard control will be used, providing independent control of each propelling motor and arranged for operation from either the pilot house or engine room. Provision will also be made for operating both propelling motors from one generator.

One auxiliary generator will furnish excitation for the motors and generators and the other will be used for furnishing power for driving the engine room auxiliary motors, steering gear and lighting. All the auxiliaries will be electrically driven.

In addition to the propelling equipment, there will be provided two 400 horsepower, motor-driven dredging pumps. The power for these will be taken from either or both of the main generators. Under one condition of operation, both dredging pumps will be driven from one generator, the other generator furnishing power for propulsion. Under another condition of operation, when no propulsion is required, each dredging pump will be connected to a main generator and will operate independently.

The boat will measure 261 feet in length, with a beam of 43½ feet and a draft, when loaded, of 18 feet. Included among the auxiliaries, besides the steering gear, will be three ten horsepower and five horsepower

The dredge will be equipped with [illegible] handling dry material.

TRADE PUBLICATIONS

AIR COMPRESSORS.—The Champion Pneumatic Machinery Company, Chicago, Ill., has recently issued a catalogue describing the line of air compressors for industrial and automotive requirements produced by this company.

WELDING AND CUTTING APPARATUS.—The Alexander Milburn Company, Baltimore, Md., has prepared two booklets covering first, welding and cutting apparatus and acetylene generators made by the company; and, second, a description of the Milburn light, which consists of a portable acetylene generator and various combinations of lights and reflectors.

MARINE LIGHT AND POWER PLANTS.—Under this title the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a catalogue dealing with power plants for marine service. The plant consists of a gasoline or kerosene engine driving a generator charging either a 110 or 32-volt battery which is adaptable for service and emergency lighting in all classes of self or non-propelling craft and lighthouses.

OIL ENGINES.—A catalogue of general information on the Sun-Doxford, opposed piston, solid injection oil engine, as built by the Sun Shipbuilding and Dry Dock Company, Chester, Pa., has just been sent out by this company. The engines so far built by the Sun Shipbuilding and Dry Dock Company are exact duplicates of the engines built by the William Doxford Company in England. The features claimed for this engine are its absence of valves, perfect scavenging requiring low scavenge pressure, direct reversibility, practically perfect inertia balance, relief of the cylinder from other than radial stresses caused by the gas pressure within it, relief of the crank shaft bearings from the hard service occurring in single piston 2 or 4 cycle engines and relief of the cylinder supports or columns from longitudinal stresses. In addition to working details of the engine and descriptions of its installation in various ships, a table of comparative particulars of the Sun-Doxford engine and a single piston, 4 cycle Diesel engine installation is contained in the catalogue.

DIESEL ENGINES.—Two-cycle, solid injection Diesel engines for stationary and marine service are described and illustrated in a very complete manner in a special catalogue on this subject issued by the Worthington Pump & Machinery Corporation, New York. The Worthington Diesel engine has been designed to meet the demand for a fuel oil engine having, as it is claimed, the qualities of the Diesel class while, at the same time, being of a simplified construction adapted to small sizes and capable of giving reliable service with less attention. This Worthington engine was the first American Diesel to be operated with compressed air for spraying the fuel oil and without mechanically charged spray valves requiring accurate adjustment. In its machine design the best practice is followed. All wearing parts are liberally proportioned to insure long life and the consumption of lubricating oil is low. Much of the mechanism in older type Diesel engines has been eliminated as well as all delicate adjustments. The catalogue goes into the design and operation of the engine in a very complete manner and is a real reference work on this type of Diesel engine.

The Chase Metal Works, Waterbury, Conn., has opened a sales office in Newark, N. J.

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Turkey Seeks to Replenish Her Merchant Marine

AT the time of her entry into the war Turkey's merchant marine amounted to about 110,000 tons. Of this tonnage it is estimated that less than 50,000 tons remains, and that the greater portion of this is in bad condition or obsolete.

The comparatively small tonnage of the merchant fleet at the outbreak of the war was primarily due to the inability of the Ottoman Empire to reserve Turkish coastal trade to ships under Turkish registry. Now that Turkey has limited its coastal shipping exclusively to vessels under Turkish registry, where heretofore Greece and Italy figured most prominently, a new impetus has been given to the development of a national merchant marine, says Vice Consul E. A. Plitt of the State Department.

At present, a great need is felt for large sized vessels to handle the passenger traffic, but this is only temporary, the future of the country's merchant fleet being dependent largely upon the demand created by the development of Turkey's resources and industries.

World's Largest Floating Dock Under Construction

THE largest floating dock in the world is being constructed at Southampton, England. The huge dock will have a lifting power of 60,000 tons and will be able to receive the largest war or mercantile vessel yet built or contemplated, its total overall length being 960 feet.

The big dock is of the double-sided sectional box type and consists of pontoon and two parallel walls divided transversely into seven sections.

The dock is being built by the Sir W. G. Armstrong Whitworth & Co., Ltd., Newcastle-on-Tyne, Eng.

New French Steamship Company Formed; Foreign Owners Order Vessels in France

By Our Paris Correspondent

IN the article which appeared in the January issue I alluded to the growing importance of the steamship company Les Chargeurs Francais, which, following the purchase of the fleet of the bankrupt company Les Affreteurs Reunis, now ranks fourth among the French steamship companies for the tonnage owned. The new company, which is to operate the fleet of the Affreteurs Reunis under the control of the Chargeurs Français, has now been constituted under the name of "Compagnie des Affreteurs Français," with a capital of 15,000,000 francs, formed by issuing 60,000 new shares of the Chargeurs Français.

It seems that the Chargeurs Français are not yet satisfied with that considerable increase of their fleet, as they decided some weeks ago to place with the Chantiers Navals Français (a French shipyard which was in great need of work) an order for the construction of six colliers of 2,875 tons deadweight, which will be designed to be self-trimmers. That important order has aroused much interest in this country at a time when the shortage of orders for new vessels has attained severe proportions. And, as pointed out above, what is most surprising in that development is that this order of an abnormal importance under the present circumstances has been placed by a company which has just acquired a fleet much more considerable than its own tonnage.

While orders for new vessels placed by French steamship companies have become fewer and fewer in the course of the last months, it is noteworthy that better prospects are observed as far as foreign orders are concerned, and this special point is a feature of the moment in this country; while the Chantiers et Ateliers de la Gironde have secured some months ago an order for the construction of two dredgers for a British firm and another order for a tanker of 550 tons to be built to the account of the Anglo-Saxon Petroleum Company, the Chantiers et Ateliers de Saint-Nazaire-Penhoet on the other hand have succeeded in obtaining from foreign firms some important orders, such as an order for the construction of a steam hopper barge, which was delivered some weeks ago to a British firm, and an order for a cable-laying ship, to be built to the account of the Western Union Telegraph Company. The latter vessel, which is to be named the *Cyrus Field*, will be 211 feet long; her propelling machinery will consist of two triple expansion engines, steam being supplied by two oil-fired boilers (Peabody system).

In addition to these two foreign contracts, the Chantiers et Ateliers de Saint-Nazaire-Penhoet have now just secured an order for the construction of a passenger steamer for a Finnish firm, the Finska Angfartygs Aktiebolaget, Helsingfors. This ship is to be 301 feet 10¼ inches long; her propelling machinery will consist of one reciprocating engine, steam being supplied by four oil-fired boilers. The service speed will be about 15 knots. Passenger accommodations will be provided for 106 first class, 35 second class and 250 third class passengers. The vessel is to be run on the Finland-England line of the above company. It is learned that the vessel shall be fitted with the Howden-Ljungstrom system of air-preheater, which is quite an innovation in this country.

Although the results of the management of the Compagnie Generale Transatlantique (French Line) for 1923 have shown signs of improvement as compared with the preceding year, the board of that firm has decided that no installment on dividends shall be paid to shareholders on January 1 as usual in prosperous years. There is much speculation as to whether this firm will be capable of paying a dividend in May 1924 when the accounts for 1923 have been gone into.

The directors of the French Line are awaiting with keen interest the discussion which is to take place in Parliament in respect of the draft bill providing for the financial arrangements to be made with a view to enabling the company to place the order for the construction of a large new liner of the *Paris* type. The Committee for Mercantile Marine at the Chamber of Deputies examined the bill some weeks ago and it is expected that the discussion thereon will come shortly. In the meantime the French Line has invited tenders from several large French shipyards for the construction of that liner which according to recent reports should have a displacement of 40,250 tons. (It is interesting to note that the displacement of the *Paris*, the largest French ship afloat is only 37,198 tons.)

Interesting reports are available in connection with the new passenger vessel *De Grasse*, under construction at the yards of Messrs. Cammell Laird and Company, Birkenhead, to the account of the Compagnie Generale Transatlantique, to which I referred in my last month's article; following the end of the boiler makers' lock-out, the work has been resumed with full activity and it is reported that the ship will be delivered to the owners by the end of July so that she may be placed in service early in August.

(Photograph by Keystone View Co.)

Salvaging of the Richard Welford

The *Richard Welford* of the Tyne-Tees Shipping Company, which sank alongside Newcastle Quay, Newcastle, England, while discharging cargo, was successfully raised by salvage contractors in three hours. The illustration shows how the vessel appeared before work was started on it.

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Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPBUILDING AND REPAIRS

Miscellaneous Repairs, Oakland, Cal.—The Hanlon yard was low bidder for drydocking, cleaning and painting the steamer Pallas.

Damaged Plates Repaired, Toledo, Ohio.—Steamer Robert L. Ireland has been placed in drydock at Toledo for repairs to 23 damaged plates.

Ore Carrier Drydocked, Philadelphia, Pa.—The ore carrier Kiruna has been drydocked at the Cramp Shipyards for painting and miscellaneous repairs.

Boiler Tube Repairs, Philadelphia, Pa.—Tanker Watertown has docked at the Philadelphia Tidewater Terminal for repairs to defective boiler tubes.

Cleaning and Painting, San Francisco, Cal.—The ferryboat San Pedro, of the Santa Fe Railroad, has been placed on the Bethlehem ways for cleaning and painting.

Boston Lightship Repairing, Chelsea, Mass.—The Boston Lightship has been withdrawn from its station and will be under repairs at the Chelsea depot for a few weeks.

Steamer Overhauling, Baltimore, Md.—For repairs, the Blake Line steamer Blair has been placed on the ways of the Maryland Drydock Company by the Shipping Board.

Low Bidder, Oakland, Cal.—The Hanlon Drydock Company submitted the lowest bid for repairs to the steamer West Cactus, the work including the engine and deck departments.

Sand Digger Construction, Paducah, Ky.—The Western Rivers Company, Point Pleasant, W. Va., is having a sand digger built at the Ayer and Lord Marine Ways, Paducah, Ky.

Reconditioning, West Coast.—Bids have been received by the Pacific Mail Steamship Company for reconditioning of the steamer City of Para, the work to cost approximately $15,000.

Repairs and Painting, Philadelphia, Pa. — The Japanese steamship Portland Maru is at the yard of the Cramp Ship & Engine Building Company for miscellaneous repairs and painting.

Liner Drydocked, Chester, Pa.—The Black Diamond liner Innoco has been drydocked at the Sun Shipbuilding and Drydock Company's yards, Chester, for miscellaneous repairs and painting.

Inspection, Painting, etc., Baltimore, Md.—The Shipping Board steamer West Cohas has been placed on the Bethlehem Shipbuilding Corporation's Baltimore plant, ways for inspection, repairs and painting.

Annual Winter Overhauling, Chester, Pa.—The Sun Shipbuilding and Drydock Company has received the contracts for giving the two army dredges, New Orleans and Gillespie, their annual winter overhauling.

Thorough Overhauling, Seattle, Wash. — The steamer Dorothy Alexander is being thoroughly overhauled and reconditioned in preparation for going on the run out of Portland to California ports.

Passenger Vessel Drydocked, Chester, Pa.—The Persian, of the Merchants' and Miners' Line, has been drydocked at the Sun Shipbuilding & Drydock Company's yards for miscellaneous repairs and painting.

George Washington Drydocked, Boston, Mass.—The George Washington, operated by the United States Lines, is drydocked at Boston for necessary repairs and overhauling, which will occupy a period of several weeks.

Plates Repairing, San Francisco, Cal.—Bids for drydocking and repairing of damaged shell plates on steamer Glymont, recently received, were as follows: General Engineering, $1,420; Bethlehem, $1,649, and Moore Drydock Company, $2,200.

Spud Points for Dredge Boat, Pittsburgh, Pa.—The Marine Manufacturing & Supply Company, Pittsburgh, Pa., has been awarded a contract by the General Contracting Corporation, Pittsburgh, Pa., for spud points for the dredge boat Pelican.

Yacht Overhauling, Jacksonville, Fla.—The yacht Captavia, owned by Payne Whitney, New York millionaire, has been taken to the Gibbs shipyard in South Jacksonville for drydocking. She will be repainted and her exterior and engines will be overhauled.

Conversion to Cabin Ship, England.—Upon her return to Liverpool, the new Cunard liner Tyrrhenia, 17,000 tons, is to be converted into a cabin ship. She will carry cabin and third-class passengers only. She was designed and built to carry three classes of passengers.

Radio Service on Vessels.—Announcement has been made by the Radio Corporation of America that it has closed contracts for providing radio service on the following ships: Huguenot, Challenger, Elena Valdez, Emma Alexander (ex-Nanking) and M. V. Challambra.

Ship Work, Hoboken, N. J.—The steamships Montana, President Van Buren, President Polk, President Monroe, Clement Smith, and Munmotor, are among the vessels recently awarded the W. & A. Fletcher Company, Hoboken, for various engine, hull and superstructure repairs.

Contract Awarded, Savannah, Ga.—The contract for repair work on the steamship Tulsa has been awarded to John Rourke & Sons, Savannah, Ga., at a price of $7,475. The same concern also received the contract awarded by the Shipping Board for repairs to the steamship Ophis.

Increase of Steerage Space, West Coast.—It has been announced that the Shipping Board is considering increasing the steerage space on the liner President Lincoln to give her approximately the same steerage capacity as the other four liners operated by the Pacific Mail Steamship Company.

Steamer Inspection, Chester, Pa.—Steamer Jeanette Skinner, of the Shipping Board fleet, has been placed on the Sun Shipbuilding and Drydock Company's drydock for inspection to determine the nature, cost and extent of repairs necessary to condition the vessel for going on spot berth.

Extensive Repairs, Mobile, Ala.—Mexican Eagle Oil Company's tanker San Antonio was lifted on the dock of the Alabama Drydock & Shipbuilding Company for bottom repairs, cleaning and painting, and examination of rudder, tailshaft, etc. Repairs are to be made to machinery and auxiliaries, boilers, etc.

Voyage Repairs, Oakland, Cal.—The Crowley Shipyard was the successful bidder for voyage repairs on the freighter Glymont at recent opening of tenders. Prices were: Crowley, $1,850; Bethlehem, $2,073; Hanlon, $2,500; United Engineering, $2,854; General Engineering, $3,750; Moore Drydock Company, $3,987.

Salina Overhauling, San Francisco, Cal.—Bids for repairs and renewals on the steamer Salina, recently opened on the West Coast, showed the General Engineering & Drydock Company as low bidder with a price of $4,131, other tenders being submitted by the Bethlehem Shipbuilding Corporation, $6,350, and Moore Drydock Company, $5,507.

Motor Tugs Launched, Baltimore, Md.—The Spedden Shipbuilding Company has launched two of four steel motor tugs under construction for the United States Engineer Corps for delivery to the officer in charge of the Philadelphia district. The vessels, each 50 feet long, are to have Diesel engines; three the Mianus-Diesel, and one the Kahlenberg type.

Miscellaneous Work, Oakland, Cal.—The Crowley Shipyard was successful bidder for the work of placing storm hatches and hardwood gratings over all steerage hatches on the President Cleveland of the Shipping Board. The prices are as follows: Crowley, $2,265; Bethlehem, $2,386; United Engineering, $3,189, and General Engineering, $3,300.

Dredge Launched, San Francisco, Cal.—The dredge Frank M. Shallue was launched from the ways of the Bethlehem Shipbuilding Corporation recently for the Pan-Pacific Dredging Company. The dredge was built for clearing the West Basin, a contract with the Pan-Pacific Company calling for expenditure of $600,000, and the dredging of the East Basin at a cost of $100,000.

To Be Placed in Condition, Seattle, Wash.—Steamship Curacao, plying between Seattle and California ports for the last six months, will be withdrawn in the near future and put in condition to relieve the Southeastern Alaska liner Admiral Rodgers at once. The Admiral Rodgers is to undergo extensive overhauling and conditioning for the coming summer season.

Installation of Telephone and Telegraph Sets, West Coast.—The Radio Corporation of America has been awarded contracts to install two 200-watt combination telegraph and telephone sets on the Wrigley steamer Catalina, now building in the south, and aboard the Union Oil tanker Montebello. The Admiral Line has also ordered a similar set for its steamer Admiral Dewey.

Freighter Repairs, San Francisco, Cal.—At the opening of tenders for repairs to the freighter West Islip, of Swayne & Hoyt, Inc., General Engineering and Drydock Company submitted the lowest price, the bids being as follows: General, $1,856; Moore Drydock Company, $1,983; Crowley's, $2,006; Hanlon, $2,248; Bethlehem, $2,275; United Engineering, $2,375, and Smith Machine Works, $3,298.

Shipyard Work, Chester, Pa.—Hopper dredges Nos. 58 and 59, of the Government, have been drydocked at the Sun Shipyards for a general overhauling. The Clan Skene, steamer of the Cunard Line, has been docked at the same yard for repairs; tanker Gulfqueen, of the Gulf Refining Company's fleet, and steamship Dryden have also been drydocked for miscellaneous repairs and painting.

Shipyard Activities, Buffalo, N. Y.—The Buffalo Drydock Company is engaged in the following work: M. A. Hanna Line steamer Agassiz, bottom repairs and removal of fifty-six plates; Perry-Victoria Sand Company's sand sucker Victoria, bottom and wheel repairs; and sand sucker Catherine, sand dredge Elco, and tug Major Kingman, owned by D. Hyman & Company, bottom and minor repairs.

Successful Bidder, San Francisco, Cal.—The Bethlehem Shipbuilding Corporation was successful bidder at recent tender openings in California for general repairs and overhauling of the Associated Oil tanker Alden Anderson, the following proposals having been submitted: Bethlehem, $3,480, six days; General Engineering, $3,497, seven days; Moore Drydock Company, $3,689, six days, and Main Iron Works, $4,004, ten days.

Rudder Post Installation, Oakland, Cal.—At a price of $1,000, the Hanlon Shipbuilding Company, Oakland, tendered the lowest bid for installing a rudder post on the lumber steamer John C. Kirkpatrick, of the Andrew F. Mahony fleet. Other companies submitting proposals were: General Engineering, $1,475 and five days; Moore, $2,433 and nine days, and Bethlehem Shipbuilding Corporation, $2,936 and seven days.

Shipyard Activities, San Francisco, Cal.—The General Engineering and Drydock Company is engaged in the following work. Steam schooner Pasadena

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new rudder post, new stern frame and a skagg; steam schooner Helene, general repairs and caulking; steam schooner Columbia, completion of installing new stern frame; G. C. Lindauer, general repairs, and ferryboat Aven J. Hanford, drydocking and extension of rudder area.

Drydocking and General Repairs, San Francisco, Cal.—At the opening of tenders by the Shipping Board for drydocking and general repairs to the West Carmargo, the General Engineering and Drydock Company submitted the lowest bid, the prices being as follows: General Engineering, $3,045; Hanlon, $3,245; Bethlehem, $3,106; Eureka Boiler Works, $3,249; Moore Drydock Company, $3,627; Main Iron Works, $4,165, and the United Engineering Company, $4,785.

Shipyard Work, Mobile, Ala.—The Alabama Dry Dock & Shipbuilding Company, Mobile, has received the following ship work: Shipping Board steamer Wytheville, to have new rotor installed; Mobile Coal Company's barge Choctaw, to have 63 foot 5 inch mast installed; Bessemer City repairs, including voyage repairs, alterations, machine and boiler work, etc.; tug Nimrod, installation of a new wheel, tail shaft and rudder job; and tug Starling, renewal of stern bushing and air pump repairs.

Reconditioning Contracts, Baltimore, Md. — The Maryland Drydock Company has been awarded contracts for building additional quarters on the Bay Line steamers State of Maryland and State of Virginia. The Clauseus, of the Planet Line, and the Pacific, of the Argonaut Line, are also undergoing repairs at the same yards. The company recently completed overhauling the Robin Gray of the Seas Shipping Company, at a total cost of about $20,000, and the West Lake, of the Shipping Board, at approximately $13,000.

Voyage Repairs, etc., San Francisco, Cal.—At the opening of bids for voyage repairs and alterations to increase the refrigerating space on the U. S. transport Meigs, the General Engineering and Drydock Company, of San Francisco, was low, the prices being as follows: General Engineering, $3,386; Christie Machine Works, $3,700; Theodore Smith Company, $3,908; Hanlon's, $3,975; Columbia Machine Works, $3,983; Neptune Machine Works, $4,408; Bethlehem, $4,503; Main Iron Works, $4,688; and Moore Drydock Company, $5,935.

Correction.—On page 129 of our February issue it was erroneously stated that the steamers Prince George and Prince Rupert will dry dock for annual overhaul in Vancouver. These vessels have been assigned to the Prince Rupert Dry Dock & Shipyard, Prince Rupert, B. C. The Prince George overhaul is now practically completed and the Prince Rupert will be overhauled in March. Other work in hand at this yard at present is as follows: Annual overhaul of Dominion Government steamship Newington; overhauling steam trawlers Andrew Kelly, George E. Foster and James Caruthers of the Canadian Fish & Cold Storage Company; overhaul and hull repairs to barge Griff of the Coastwise Steamship & Barge Company, and hull repairs to Canadian National car ferry recently started.

PORT IMPROVEMENTS

Grain Elevator, Gainesville, Tex.—Keel & Son plan grain elevator, at a price of $40,000.

Canal, Bartow, Fla.—Bids were received by C. V. Turner, city manager, Bartow, on February 15, for a 4½-mile canal, $35,000.

Canal Terminal, Troy, N. Y.—Commissioner of Canals, 55 Lancaster Street, Albany, will soon take bids for a barge canal terminal, here. $300,000.

Deck on Wharf, Sacramento, Cal.—The city of Sacramento will build concrete deck on wharf, by day labor, under the supervision of A. Givan, city engineer. $40,000.

Dock, South St. Louis (St. Louis P. O.), Mo.—National Lead Company, International Life Building, St. Louis, plans terminal dock on Mississippi River, at Canary Plant, here. To exceed $25,000.

Wharf, Pembroke, Ont. — The Department of Public Works, Parliament Building, Ottawa, awarded the contract for constructing a new wharf, Pembroke, to W. Bermingham, Kingston. $116,000.

Contract Awarded, Norfolk, Va.—The Calkins Dredging Company, of Norfolk, Va., has been awarded a contract for dredging certain lakes at Buzzards Bay, Mass., by W. E. Corey, of N. Y.

Levee, Ferris, Tex.—Ellis County Levee Improvement District 5, Waxahachie, plans election soon to vote on $65,000 bonds for levee improvements, near Ferris. C. T. Forest, Waxahachie, engineer.

Docks, Cleveland, Ohio—Erie Railroad, 50 Church Street, New York City, plans improvement of ore docks, here, including new ore unloader and apparatus. $500,000. H. O. Dunkle, Scranton Avenue, Cleveland, general agent.

Large Dock, Glasgow, Scotland.—Word has been received from Scotland that Glasgow is to have the largest dock in Great Britain, to cost $10,000,000, cover 40 acres of water and to accommodate the largest vessels touching this port.

Canals, etc., Dixon, Cal.—Dixon Reclamation District plans to reclaim and irrigate 30,000 acres. Will install pumping plants and construct 17 miles of main canal and 40 miles of laterals. To exceed $950,000. F. C. Herman, Merchants Exchange Building, San Francisco, consulting engineer.

Contract Awarded, St. Catharines, Ont.—J. W. Pugsley, secretary of the Department of Railways & Canals, Parliament Building, Ottawa, awarded the contract for constructing Section 8, Welland Ship Canal, near Port Colborne, to A. W. Robertson, Ltd., 260 St. James Street, Montreal, Que., at $10,528,215.

Wharf, New Orleans, La.—The Engineering Department of Dock Board, 1 Canal Street, is preparing plans and will take bids about March 1 for raising timber wharf, 900 feet long and 260 feet wide, and rat-proofing rear platforms of wharf at foot of Erato Street, the work involved being 260 feet wide and 900 feet long. $450,000.

Vertical Boiler, New Orleans, La.—Sealed proposals were received by the Board of Commissioners of the Port of New Orleans, Suite 200, New Orleans Court Building, on February 28, for furnishing a 72-inch by 14-foot 6-inch vertical boiler, fittings and stack for an unloading tower. Requisition E. D. 14598. J. H. Walsh, general manager.

Contract Awarded, Cape May, N. J.—The Hill Dredging Company, Atlantic Avenue, Atlantic City, has received the contract awarded by the Board of Commerce & Navigation, State House, Trenton, for redredging 11,000 feet of inland waterway in Grassey Sound Channel, Richardsons Channel and Suaires Channel, Cape May County. $0.60 per cubic foot.

Canal, Shrewsbury, La.—On February 12, the Board of Commissioners, 4th Jefferson District of Jefferson Parish, took bids for a 50-mile canal, 8-12 feet deep, 40-70 feet wide, 10 feet high, 120-foot base, in Sub District 3; also pumping stations, etc., $1,500,000. A. T. Dusenbury, Room 407, Marine Bank Building, New Orleans, consulting engineer.

Dike, etc., Washington.—Skyhomish Reclamation County plans to reclaim 9,000 acres of land in Padilla Bay District, in Skagit and Whatcom Counties. Work includes dyke 8 miles long, 5-20 feet high and 335 feet wide at base, around Padilla Bay. $1,300,000. F. Waldron, Seattle, general manager. F. C. Brown, Lyon Building, Seattle, attorney.

Pier, San Francisco, Cal.—The State Board of Harbor Commissioners, Ferry Building, have had working plans approved for a 385 by 600 foot pier, concrete and pile; also two sheds and railroad track, foot of Third Street, $1,500,000-$2,000,000. Bids will be asked when the State Treasurer authorizes sale of $2,000,000 bonds. F. G. White, Ferry Building, engineer.

Dredge and Fill, Vancouver, B. C.—The Canadian Pacific Railway, Windsor Station, Montreal, Que., awarded the contract for dredging mud from the bottom of inlet and filling in with rock and gravel for foundation of new pier, 75,000 cubic yards of floating dredgework and 400,000 yards rock and gravel, to Northwestern Dredging Company, 510 Hastings Street West, $60,000.

Contracts Awarded, Brooklyn, N. Y.—E. Riegelmann, borough president, Boro Hall, awarded the contract for dredging 15,000 cubic yards scow measurement in Gowanus Canal, and 20,000 cubic yards in Wallabout Canal, to W. E. Potter, $14,535 and $15,980 respectively; 40,000 cubic yards in Newtown Creek, to J. McSpirit, $25,600; 40,000 cubic yards, foot of 64th Street, to Columbia Dredging Corporation, 30 Church Street, New York, $11,160.

Contracts Awarded, Lake Charles, La.—Police Jury Calcasieu Parish, Court House, awarded the contracts for constructing Section 3, Navigation Channel, from Station 714 to 580, 2.54 miles, 2,020,000 cubic yards excavation, to Atlantic Gulf & Pacific Company, 13 Park Row, New York City, $212,000; Section 5 of Navigation Channel, from Station 58 to 322, 5 miles, 4,480,000 cubic yards excavation, to Hampton Reynolds, Guarantee Title Building, New Orleans, $394,980.

GOVERNMENT WORK

Dredging, Plymouth Harbor, Mass.—Sealed proposals were received on February 25 for dredging in Plymouth Harbor, Mass.

Dredging, Providence, R. I.—The War Department, Chief of Engineers, Washington, D. C., plans dredging in Connecticut River.

Steel Dump Scow, Duluth, Minn.—Bids were received on February 28 by the U. S. Engineer Office, Duluth, Minn., for one steel dump scow.

Yellow Pine, Owensboro, Ky.—Louisville Engineer Office is in the market for 500,000 feet, board measure, yellow pine, f. o. b., Owensboro, Ky.

Dike and Sluice, Killochook Meadows, N. J.—War Department, Chief of Engineers, Washington, D. C., plans dike and sluice in Delaware River, here.

Steel Boat Hulls, Louisville, Ky.—U. S. Engineer, P. O. Box 72, plans to purchase three steel maneuver boat hulls for Cincinnati District, 24 by 60 feet.

Lock, Fayetteville, N. C.—O. O. Keuntz, district engineer, Wilmington, will make surveys for new lock on Cape Fear River between Fayetteville and Wilmington, N. C.

Bids Rejected, New York, N. Y.—U. S. Engineer, Army Building, Whitehall Street, rejected bids on January 14 for dredging in harbor at Flushing Bay, 1st District.

Dredging, Chelsea, Mass.—Sealed proposals were received on February 25 by District Engineer, Custom House, Boston, for dredging at lighthouse depot, at Marginal Street, Boston.

Bars, Washers, etc., Louisville, Ky.—U. S. Engineer Office, P. O. Box 72, Louisville, Ky., opened bids on February 19 for 3,200 round bars, ⅞ inch by 22 feet, and washers and nuts, etc.

Dike, Mare Island, Cal.—Specification 4941.—Bureau of Yards & Docks, Navy Department, Washington, D. C., plans repairs to north breakwater pier at Naval Base, Mare Island.

Vertical Boiler, St. Louis, Mo.—The P. A. Rohan Boat, Boiler & Tank Company, St. Louis, Mo., has a contract for one vertical boiler awarded by the U. S. Engineer Office, Peoria, Ill., at $650.

Breakwater Pier, Hampton Roads, Va.—Specification 4944.—Bureau of Yards & Docks, Navy Department, Washington, D. C., plans repairs to north breakwater pier at Naval Base, here.

Channel, Tillamook, Ore.—U. S. Government, Tillamook, is having surveys made for a 24-foot channel through Tillamook Harbor to ocean. G. Mayo, Post Office Building, Portland, engineer.

Mooring Mast, Ft. Worth, Tex.—Specification 4939—Bids were received on February 13, by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for erecting mooring mast, here.

Breakwater Construction, Gulfport, Miss.—The U. S. Engineer Office, Mobile, Ala., will soon take bids on the construction of a breakwater of creosoted timber on Mississippi Sound, near Gulfport, Miss.

Probable Re-advertisement of Bids, Mobile, Ala.—U. S. Engineer, Mobile, Ala., will probably ask for bids again on a 134-foot steel hull towboat. Tenders received recently were rejected as excessive.

Shore Pipe, Galveston, Tex.—U. S. Engineer, Galveston, Tex., has awarded the contract for furnishing 17,000 feet of shore pipe for pipe-line dredges to the Kane Boiler Works, Galveston, Tex., at $2,395.

Air Receivers and Oil Tank, Louisville, Ky.—U. S. Engineer Office, Louisville, will be in the market soon for two air receivers, 66 inches diameter and 18 feet long, designed for 120 pounds

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pressure with factor of safety of 5 and for an oil tank 43 inches in diameter, 6 feet 6 inches long, for Dam 44, Leavenworth, Ind.

Bids Re-advertised for Quarterboat, Huntington, W. Va.—U. S. Engineer Office, Huntington, opened bids on February 28 for one steel hull quarterboat, the former bids received having been rejected as excessive.

Steel Crane, Milwaukee, Wis.—U. S. Engineer, Federal Building, awarded the contract for one revolving steel crane to McMyler Interstate Company, Stop 27, A, B and C Electric Railway, Cleveland, Ohio, at $19,200.

Low Bidder, St. Paul, Minn.—American Hoist & Derrick Company, St. Paul, Minn., was low bidder at $4,032, for two steel derricks for the U. S. Engineer Office, Vicksburg, Miss. Eight other firms also submitted proposals.

Douglas Fir, New York, N. Y.—Charles R. McCormick Company, New York City, submitted the lowest bid at $29.17 per M. (total $11,550) for furnishing 396,000 feet of Douglas Fir to the Mare Island Navy Yard, California.

Derrick for Maneuver Boats, Louisville, Ky.—Louisville Engineer Office is preparing plans for five steel stiff leg derricks for maneuver boats. The derricks will be of about 8 tons capacity, 40 feet boom and mast 28 feet tall.

Contract Awarded, Duluth, Minn.—The contract for one steel spud for U. S. dredge Gaillard has been awarded to the Marine Iron & Shipbuilding Company, Duluth, Minn., by the U. S. Engineer Office, that city, at a price of $4,315.

Generating Set, Rock Island, Ill.—Engberg's Electric and Mechanical Works, St. Joseph, Mich., was low bidder at opening of tenders by the U. S. Engineer Office, Rock Island, Ill., for one generating set for U. S. towboat Nauvoo, at $624.

Pipe Line Award, Birmingham, Ala.—U. S. Engineer Office, Jacksonville, Fla., has awarded the contract for 1,400 feet of shore pipe line for dredge (20 inches diameter ⅝-inch steel) to Welded Products Company, Birmingham, Ala., at $5,950 and 90 days.

Dredging, Stamford and Greenwich, Conn.—Sealed proposals will be received until 12 M., March 4, 1924, at the U. S. Engineer Office, Providence, R. I., for dredging in Stamford and Greenwich Harbors, Conn. Further information on application.

Generating Sets for Towboat, Louisville, Ky.—The United States Engineer Office, Louisville, will soon be in the market for one 8-kilowatt, 110-volt electric generating set and one 6-kilowatt, 110-volt reciprocating electric generating set to be installed on towboats.

Mooring Mast, San Diego, Cal.—Specification 4916—Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded the contract for a mooring mast at Naval Base, San Diego, to De-Ward & Cobham, 207 Granger Building, $10,997 and 60 days.

Low Bidder, Newport News, Va.—At the opening of tenders by the Bureau of Yards & Docks, Navy Department, Washington, D. C., for mooring mast at Fort Worth, Tex., the Newport News Contracting & Engineering Company, Newport News, Va., was low at $14,700.

Contract Awarded, Hampton Roads, Va.—Specification 4935—Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded the contract for dredging Naval Operating Base at Hampton Roads to the Norfolk Dredging Company, 71 Compostella Road, Norfolk, $0.188 per cubic yard.

Electric Generators, etc., Florence, Ala.—Sealed proposals will be received until 11 A. M., March 22, 1924, by the U. S. Engineer, Florence, for furnishing and delivering four electric generators, each of 32,500 K.V.A. capacity, with exciters and accessories. Further information on application.

Award Recommended, Louisville, Ky.—J. & J. B. Milholland Company, Pittsburgh, Pa., was low bidder on two lots of material for Lock No. 46, Ohio River, Owensburg, Ky., at the opening of bids by the Louisville Engineer Office, as follows: River wall valves (44 tons cast iron castings and 10 tons of steel castings), $9,650, and 28 tons of reinforcing bars, etc., at $1,979, or a total of $11,629.

Miscellaneous Equipment, Florence, Ala.—Sealed proposals will be received until 11 A. M., March 4, 1924, by the U. S. Engineer Office, Florence, for furnishing and delivering one switchboard, one storage battery, two motor generator sets, six 500-K.V.A. transformers, one high-potential testing set, and one rotary converter, for the powerhouse of Wilson Dam, Tennessee River. Further information on application.

Steel Derrick, St. Paul, Minn.—The American Hoist & Derrick Company, St. Paul, Minn., was low bidder and received the contract for one steel derrick, at $4,241, for the U. S. Engineer Office, St. Paul, Minn.

Sheet Piling, Pittsburgh, Pa.—Carnegie Steel Company, Pittsburgh, has received the contract for furnishing and delivering by river the following: 1,220 tons of steel sheet piling for Dam 46, Owensboro, Ky.; 300 tons of steel sheet piling for Dam 45, Addison, Ky.; all at $57 per ton delivered.

Boilers, Montgomery, Ala.—The U. S. Engineer Office, Montgomery, Ala., will open bids on March 3 for two upright boilers with submerged tubes.

Dike, etc., Delaware City, Del.—U. S. Engineer, Philadelphia, Pa., will open bids on March 20 for constructing pile, timber, and stone dike and sluice in Delaware River opposite Delaware City, Del.

NEW INCORPORATIONS

Shippers' Service Company, capital $10,000, chartered under Delaware laws.

Central American Shipping and Trading Company, Delaware, incorporated under Delaware laws.

Elder & Mittnacht, of Wilmington, Del., capital $100,000, chartered under Delaware laws, to operate steamships.

Williams Towing Corporation, of Manhattan, chartered at Albany with 100 shares of common stock of no par value. Incorporators: W. A. Knight, P. J. Dobson, and W. J. Eldredge.

Delaware Breakwater Terminal Corporation, capital $15,000,000, chartered at Dover, Del., to provide port and terminal facilities. Incorporators: Hiram R. Burton, William F. Townsend and Frank S. Carter.

The Cherokee-Seminole Steamship Company, capital $100,000, incorporated under Maine laws. Directors: Hollis B. Cole, of Eliot, Me., president; Harry E. Roberts, of Eliot, treasurer; Aaron B. Cole and George D. Boulter, of Eliot, and John G. Gredler, of Douglaston, N. Y.

The American Transport Corporation, capital $25,000, chartered under Delaware laws for the purpose of making purchase of steamers, etc. Officers: George W. Sterling, president; Thor Eckert, vice-president; Addison Outwater, secretary; and W. S. Silver, treasurer. In addition, Colonel A. E. Clark, a former Oregon attorney, is a member of the board of the new concern, of which Albert Jensen is a shareholder.

MARINE SOCIETIES

AMERICA

American Society of Naval Engineers
Navy Department, Washington, D. C.
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Society of Naval Architects and Marine Engineers
29 West 39th Street, New York
Secretary and Treasurer—Daniel H. Cox.

National Association of Engine and Boat Manufacturers
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Secretary—R. R. A. Hand.

United States Naval Institute
Naval Academy, Annapolis, Md.
Secretary and Treasurer—Commander H. K. Hewitt, U. S. N.

American Marine Association
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The New York Tow Boat Exchange
11 Moore St., New York.
Secretary—Irving G. Keller.

Port of New York Authority
11 Broadway, New York
Chairman—E. H. Outerbridge.
Secretary—William Leary.

National Association of Masters, Mates and Pilots
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

American Society of Marine Designers
Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass.

National Marine Engineers' Beneficial Association
Headquarters 311-315 Machinists Building, Washington, D. C.
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1600 Walnut Street, Philadelphia, Pa.
Secretary—C. S. King.

Council of American Shipbuilders, Inc.
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American Steamship Owners' Association
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United States Ship Operators' Association
149 Broadway, New York
President—C. H. Potter.

National Merchant Marine Association
Munsey Bldg., Washington, D. C.
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The Maritime Association of the Port of New York
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Lake Carriers' Association
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Ocean Association of Marine Engineers
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CANADA

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GREAT BRITAIN

Institution of Naval Architects
Adelphi Terrace, London, W. C.

Institution of Engineers and Shipbuilders in Scotland
39 Elmbank Crescent, Glasgow.

Northeast Coast Institution of Engineers and Shipbuilders
Bolbec Hall, Westgate Road, Newcastle-on-Tyne

Institute of Marine Engineers, Incorporated
85/88 The Minories, London, E.1.

ITALY

Collegio Degli Ingegneri Navali e Meccanici in Italia

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